Health and Safety Plan
for
Phase II Remedial Investigation
for

Naval Submarine Base - New London
Groton, Connecticut

#91

Northern Division
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 0129

October 1993

Halliburton NUS
CORPORATION

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HEALTH AND SAFETY PLAN
FOR
PHASE II REMEDIAL INVESTIGATION
FOR
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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1.0 INTRODUCTION

This Health and Safety Plan (HASP) has been developed to provide practices and procedures for Halliburton NUS and subcontractor personnel engaged in investigatory activities at Naval Submarine Base - New London (NSB-NLON), located in Groton, Connecticut. This HASP has been developed to conform to the requirements of OSHA Standard 29 CFR 1910.120 - "Hazardous Waste Operations and Emergency Response," and is based on available information regarding possible contaminants and physical hazards that may be encountered during the performance of the planned activities. If more information concerning the types or quantities of site contaminants or other potential hazards becomes available, this HASP will be modified accordingly. It will be the Halliburton NUS Project Manager's responsibility to communicate any such information to the CLEAN Health and Safety Manager (Matthew M. Soltis) who will, in turn, determine the need for any HASP modifications.

1.1 KEY PROJECT PERSONNEL AND ORGANIZATION

The purpose of this section is to establish responsibility for site safety and health as required by the aforementioned OSHA standard (see Table 1-1). The Halliburton NUS Project Manager (PM) is responsible for the overall direction and implementation of health and safety for this project. The Halliburton NUS Field Operations Leader (FOL) is responsible for implementation of this HASP with the assistance of an appointed Site Safety Officer (SSO). The activities of the SSO are monitored by the CLEAN Health and Safety Manager (HSM) for compliance with this HASP and the CLEAN Health and Safety Management Plan.

The NSB-NLON on-scene coordinator identified for this effort is Mr. Dick Conant, located at the Public Works Office in Building 135. He can be reached at (203) 449-2276.

Halliburton NUS subcontractor personnel performing operations on this project will be responsible for observing the requirements and restrictions of this HASP, and for complying with the guidance and instructions of the Halliburton NUS FOL and SSO.

TABLE 1-1

KEY HALLIBURTON NUS PROJECT PERSONNEL AND RESPONSIBILITIES

Name	Responsibility
Matthew G. Cochran	Project Manager (PM)
Stanley J. Conti	Field Operations Leader (FOL)
TBA	Site Safety Officer (SSO)
Matthew M. Soltis, CSP	CLEAN Health and Safety Manager (HAM)

2.0 SITE/PROJECT BACKGROUND

The Naval Submarine Base - New London (NSB-NLON) is located in southern Connecticut, in the towns of Groton and Ledyard. This facility was placed on the National Priorities List by the U.S. EPA on August 28, 1991. NSB-NLON consists of approximately 547 acres of land and associated buildings, situated on the east bank of the Thames River, and is approximately 6 miles north of Long Island Sound. Location maps of NSB-NLON are included in the Work Plan and Field Sampling Plan documents prepared for this effort, copies of which will be maintained on site throughout all activities in a manner and location that is accessible to all site personnel.

The Submarine Base was established as an official Navy yard in July 1886. The site initially moored small craft and obsolete warships and was used as a coaling station for the Atlantic Fleet. The property was officially established as a permanent submarine base in 1916. The overall base facilities were expanded and a Submarine School training facility was established in 1917. During World Wars I and II, the Submarine Base greatly expanded in size and in the number of buildings to support the submarine fleet.

The Submarine Base currently provides a base command for naval submarine fleet activities in the Atlantic Ocean. In addition, this base contains naval housing, submarine training facilities, military offices, medical facilities, and facilities for the maintenance, repair, and overhaul of submarines.

There are 13 individual areas that will be involved in the performance of the investigatory efforts of this project. Brief site descriptions for each of these sites is included as Appendix I of this Health and Safety Plan.

3.0 SCOPE OF WORK

This Health and Safety Plan addresses the activities that will be performed by Halliburton NUS and subcontractor personnel. The planned activities involved in this effort are presented in detail in the Field Sampling Plan developed for this project. The specific tasks planned to be performed and covered by this HASP include the following:

- Land surveying
- Soil gas surveying
- Geological surveying
- Installation of monitoring wells
- Monitoring well development and groundwater sampling
- Test borings and subsurface soil sampling
- Surface soil sampling
- Sediment sampling
- Surface water sampling
- Ecological studies (biological sampling and bioassays)
- Hydraulic conductivity testing
- Waste classification and disposal

These tasks, and their associated hazard potentials, are presented in greater detail in the following section of this HASP (entitled "Hazard Assessment"). One of the primary purposes of this HASP is to identify and address these potential hazards, and to specify the necessary control efforts that will be employed to minimize those threats.

There are 13 site areas included in this effort. These are as follows:

- Construction Battalion Unit (CBU) Drum Storage Area
- Over Bank Disposal Area Northeast (OBDANE)
- Rubble Fill at Bunker A-86
- Torpedo Shops
- Goss Cove Landfill
- Spent Acid Storage and Disposal Area

- Area A, which consists of the following sites
  - Landfill
  - Wetland
  - Downstream/OBDA
  - Weapons Center
- Defense Reutilization and Marketing Office (DRMO)
- Lower Submarine Base
- Thames River

As specified previously in Section 2.0, descriptions of these sites are included in Appendix I of this HASP.

4.0 HAZARD ASSESSMENT

This section describes the chemical and physical hazards that are associated either directly or indirectly with the tasks and operations described in Section 3.0 of this HASP. Measures to control these hazards are specified in Sections 5.0, 6.0, 7.0, 8.0 and 11.0 of this plan.

4.1 GENERAL HAZARD ASSESSMENT INFORMATION

In accordance with the requirements of OSHA standard 29 CFR 1910.120 and the Navy CLEAN Health and Safety Management Plan, this hazard assessment has been developed to address potential hazards for the specific site tasks and operations planned in this investigatory effort. To a large extent, this information has been summarized and tabulated in this section to provide for ease of use and ready access.

The tasks identified in Section 3.0 and Table 4-1 of this document have been divided below into intrusive and non-intrusive activities. This division is based on the potential for over exposure to site contaminants while conducting these activities; and therefore, the control measures applicable to the tasks.

The tasks which have been identified as representing the most significant hazard potentials involve those that are intrusive and include the following:

- Soil Gas Survey
- Drilling and Monitoring Well Installation
- Test Boring and Subsurface Soil Sampling

Primary emphasis concerning control measures as applicable in regards to chemical exposure will be directed at these activities.

Tasks which have been assessed as representing minimal concerns with regards to contaminant exposure are, conversely, those that are nonintrusive, and include the following:

- Land surveys
- Surface soil/water and sediment sampling
- Geological surveys
- Monitoring well development and groundwater sampling

- Ecological Studies
- Hydraulic conductivity testing
- Waste classification & disposal

These activities have been assessed to involve minimal hazard potentials to the personnel performing them. This assessment is predominantly based on the understanding that as they do not involve intrusive activities in areas with recognized potentially-contaminated media, or potential concentrations of contaminants where overexposure could occur. The nonintrusive tasks will take place separately from intrusive activities. Therefore, influencing factors, and zone restrictions associated with concurrent operations will both be a factor. PPE requirements for persons performing one of these nonintrusive low hazard tasks include: wearing standard field clothes for the onsite, nonintrusive tasks (standard field clothes include long sleeved shirts and long pants, and sturdy work boots or shoes (steel-toed if foot hazards may be encountered)); observance of proper work practices such as the use of the "buddy system," no hand-to-mouth activities, and other applicable standard work practices as specified in Section 7.0 of this HASP; and proper personal hygiene practices.

The planned work tasks are presented by site area in Table 4-1. This table has been included to illustrate which of these tasks are planned to be performed in the various site investigation areas. The recognized potential hazards associated with these tasks (and the prescribed control efforts for those hazards) are summarized and presented in Table 4-2.

Waste classification and disposal will involve the classification and disposal of investigation derived wastes such as drill cuttings, monitoring well purge waters, used items of disposable or nonreusable personal protective equipment (i.e., coveralls, boot covers, gloves, etc.), and other such items. These items will be collected and containerized and staged according to their site, as site work progresses. The containers will be plainly labelled as to their contents and staged in a stable area. Classification efforts will involve information derived from sampling and analysis of these wastes. Based on this information, those waste materials identified by concentration and identification as hazardous will be relocated and staged to await disposal at a licensed facility. Those materials identified as nonhazardous will be handled and staged in suitable containers at an area designated by the Navy, followed by disposal.

TABLE 4-1

TASKS TO BE PERFORMED BY SITE AREA
NSB-NLON
GROTON, CONNECTICUT

Site	Monitoring Wells, Borings and Sampling, Land Surveying, and Waste Classification and Disposal	Surface Soil Sampling	Sediment Sampling	Well Development, Hydraulic Conductivity Testing*, and Groundwater Sampling	Surface Water Sampling	Ecological Sampling	Air Sampling	Geologic Surveying	Soil Gas Surveys
CBU Drum Storage Area	YES	NO	NO	YES	NO	NO	NO	NO	NO
OBDANE	YES	NO	YES	YES	NO	NO	NO	NO	NO
Bunker A-86	YES	YES	YES	YES	YES	NO	NO	NO	NO
Torpedo Shops	YES	NO	YES	YES	YES	NO	NO	YES	YES
Goss Cove Landfill	YES	NO	YES	YES	YES	NO	YES	YES	NO
Spent Acid Storage and Disposal Area	YES	NO	NO	YES	NO	NO	NO	NO	NO
Area A Landfill	YES	NO	NO	YES	NO	NO	NO	NO	NO
Area A Wetlands	YES	NO	YES	YES	YES	NO	NO	NO	NO
Area A Downstream and OBDA	YES	NO	YES	YES	YES	NO	NO	NO	YES
Weapons Center	YES	NO	YES	YES	YES	NO	NO	NO	NO
DRMO	YES	NO	NO	YES	NO	NO	NO	YES	NO
Lower Subbase	YES	NO	NO	YES	NO	NO	NO	NO	NO
Thames River	NO	NO	YES	NO	YES	YES	NO	NO	NO

* Hydraulic conductivity testing will be performed only in those areas specified in the Field Sampling Plan.

TABLE 4-2

TASK-SPECIFIC HAZARD ANALYSIS
NSB-NLON
GROTON, CONNECTICUT

Task	Potential Hazards	Controls
Monitoring well installation, test borings, and subsurface soil sampling	• Exposure to site contaminants • Contact with utilities or energized sources • Contact with moving machinery • Hazards of hot work operations (i.e., fires, burns, flammable or explosive atmospheres • Exposure to heat or cold stress environments • Injury due to manual material handling activities	(1) Engineering controls such as dust suppression via area wetting (2) Proper use of PPE* (3) Proper use of real-time monitoring instruments (4) Adherence to Standard Work Practices (5) Conformance with Base and regulatory requirements for hot work operations (6) Observe heat/cold stress guidance provided in this HASP (7) Utilize proper lifting techniques, obtain assistance when necessary (8) All areas targeted for subsurface investigation will be cleared of underground utilities
Surface soil sampling	• Exposure to site contaminants • Exposure to heat or cold stress environments	Same as controls (1), (2), (3), (4), and (6) above
Sediment Sampling	• Exposure to site contaminants • Exposure to heat or cold stress environments • Drowning	(1) Same as for surface soil sampling, above (2) Observance of standard requirements (e.g., U.S. Coast Guard) for safe boating activities (3) Use of personal flotation devices and lifelines for operations at riverbanks, pond banks, or near other bodies of water
Monitoring well development, hydraulic conductivity testing, and groundwater sampling	• Exposure to site contaminants • Exposure to heat or cold stress environments	(1) Same as for surface soil sampling
Surface water sampling	• Same as above	Same as above
Ecological Sampling	• Exposure to site contaminants • Exposure to heat or cold stress environments • Drowning • Electric shock (during electroshocking operations)	(1) Same as for surface soil sampling (2) Same as controls (2) and (3) specified for sediment sampling (4) Use of appropriate nonconducting PPE, restrict unauthorized and unnecessary personnel from area, proper electrical grounding techniques, and strict observance with equipment manufacturer's recommended operating procedures

* PPE: Personal Protective Equipment

4.2 SITE SPECIFIC ASSESSMENT

In assessing these hazards for each of the 13 individual sites that are identified to be involved in this investigation, documents relating to previous site histories and investigatory activities were reviewed. Information concerning the tasks and hazards (chemical and physical) associated with those tasks are presented in the area description and (as indicated on Table 4-1), it is not necessary to address all of the tasks uniformly for each site area.

4.2.1 CBU Drum Storage Area

Previous activities conducted in this area detected volatile and semivolatile contaminants, lead, and the pesticide DDD in surface soils. However, the planned activities are intended to further evaluate the nature and extent of subsurface contamination. There are presently no drums remaining in this area. The potential for site workers to be overexposed to contaminants in the performance of planned activities are low. However, the previously detected contaminants are typically of concern from a particulate inhalation standpoint, engineering controls such as dust suppression via area wetting will be employed during intrusive activities to minimize this potential threat. Also, proper use of specified items of PPE (see Section 6.0) and adherence to standard work practices (see Section 7.0) will also be enforced. Additionally, as a precautionary measure, monitoring instrument screening of worker breathing zone areas for volatile compounds will be performed at the initiation of any site activity followed by subsequent periodic screening. These efforts will be performed at greater frequencies during intrusive activities due to the lack of information available on subsurface contamination.

4.2.2 OBDANE

Based on previous sampling and analyses, and on review of risk assessment documentation prepared by Atlantic Environmental Services, potential hazards have been assessed at minimal. In fact, the planned activities at this site are intended to verify that a "no action" remedial effort is justified. However, tetrachloroethene was detected in a previously collected surface soil sample, and the intention of planned tasks are to further evaluate subsurface contamination conditions. Adherence to standard work practices (per Section 7.0), initial and periodic monitoring instrument screening, and minimal PPE will be adequate to protect site workers.

4.2.3 Rubble Fill Area at Bunker A-86

Elevated concentrations of arsenic, polycyclic aromatic hydrocarbons (PAHs), and pesticides have been detected in surface soil samples. These substances may present an inhalation exposure threat from an airborne particulate standpoint. Also, chlorinated solvents have also been detected in this media. These substances can exist in the form of vaporous emissions. Therefore, intrusive activities will involve dust suppression controls, as well as PPE use and standard work practice observance. As a precautionary measure, initial and periodic screening of worker breathing zones for volatile emissions will also be performed during site activities. According to the Base Point of Contact (POC), there are no unexploded ordnance (UXO), energetics, Chemical Warfare Agents (CWA), or other ordnance hazard potentials in this area.

4.2.4 Torpedo Shops

Contaminants of concern at the Torpedo Shops have been identified as including low concentrations volatile organics (including benzene, 1,1,1-trichloroethane, 1,1-dichloroethene, and 1,1-dichloroethane), antimony, PCBs, and the pesticide DDE. It is possible that higher concentrations of some of these substance may be encountered in aquifers during drilling and associated subsurface sampling tasks. To minimize exposure concerns for site personnel, control efforts during intrusive activities shall include dust suppression, proper use of specified PPE, and the continuous use of monitoring instrumentation.

4.2.5 Goss Cove Landfill

Numerous contaminants have been detected at this site in both soils and groundwater media. These have been identified as including the following substances:

- Volatile organics including xylene, trichloroethene, tetrachloroethene,benzene, toluene, and vinyl chloride.
- Semivolatile organic compounds, predominantly PAHs (including naphthalene).
- PCBs.
- Pesticides, including DDT, DDD and DDE.
- Metals, including arsenic, cadmium, chromium, mercury and lead.

- Gross alpha and/or beta radiation screening values were exceeded in two groundwater monitoring well samples in this landfill. While these values may have been the result of naturally-occurring radioisotopes, they may also be indicative of contaminated wastes.

- Dioxins have also been identified as a potential site contaminant due to previous history of this site involving dibenzofuran contamination.

Tasks performed at this site will involve the use of several controls to minimize the potential hazards of worker exposures to these agents. Control efforts will include the following: use of specified items of PPE (see Section 6.0); employment of dust suppression controls during soil disturbing tasks; observance of appropriate standard work practices (see Section 7.0); and continuous use of monitoring instrumentation to detect volatile emissions in worker breathing zone areas as well as initial and periodic radiation survey meter screening, site control and proper decontamination procedures.

In addition to the concerns regarding potential exposures to site contaminants, the Base POC has also stated that previous subsurface/excavation activities at this landfill have unearthed compressed gas cylinders. If a pressurized vessel such as this would be encountered during intrusive activities such as drilling, the container could rupture. This presents both chemical and physical hazard potential concerns. In regard to chemical hazard potentials, the sudden release of a compressed gas cylinders contents could result in the hazardous airborne concentrations of the containerized substance. In considering the physical hazard potentials that could result from such an event, injury to personnel and/or property or equipment damage could result from such a sudden pressure release or flying projectiles.

In order to minimize this threat, all locations where such subsurface activities are to be performed at this site must first be subjected to a thorough magnetometer survey (or similar investigation technique). Any locations where anamolies are detected (which may be interpreted as a cylinder or other type of container) will be physically marked and avoided during any subsequent subsurface operations.

4.2.6 Spent Acid Storage and Disposal Area

The contaminants of concern at the Spent Acid Storage and Disposal Area consist of substances commonly associated with battery operations - namely, lead and acid wastes. Previous investigations have found acidic (low pH values) in soil samples. Initial screening with monitoring instrumentation for the detection of gaseous emissions will also be performed as a precautionary measure. Intrusive activities at this site will require the use of more stringent PPE, initial and periodic monitoring for gaseous emissions, observance of applicable standard work practices, and dust suppression controls as applicable.

4.2.7 Area A Landfill

Previous investigations at the Area A Landfill have detected concentrations of DDT and PCBs in surface soils, and various metals in subsurface samples (including arsenic, cadmium, lead, and selenium. Operations at this site resemble those associated with the Goss Cove Landfill previously presented. Therefore, the potential hazards and necessary controls for activities at this site are essentially the same as those presented for the Goss Cove Landfill--this includes those specified for potentials for encountering buried compressed gas cylinders, and radiological concerns and controls.

4.2.8 Area A Wetlands

Contaminants of concern at this location include: volatile organics (benzene, trichloroethene, and tetrachloroethene) previously detected in subsurface soils and sediments; semivolatile organics (principally PAHs - also in subsurface soils and sediments); pesticides (DDTR); and metals (arsenic, cadmium, chromium, lead, selenium, and silver).

Intrusive activities will require application of dust suppression controls, more stringent PPE requirements, and more frequent use of monitoring instrumentation.

In addition to the chemical hazard potentials involved activities which are planned for this site, physical hazards also warrant attention. These concerns are recognized due to several tasks involving working in or above bodies of water, and as a result of the equipment and techniques which will be used. In regard to the former, appropriate safety measures for water operations will be enforced. The latter concern is in regard to equipment used in operations such as electroshocking tasks for ecological sampling. These concerns and their associated control efforts are addressed in Table 4-2.

4.2.9 Area A Downstream and OBDA

Previous sampling efforts have detected subsurface contamination at these site areas. These contaminants have included volatile organics (trichloroethene, tetrachloroethene, toluene, 1,1-dichloroethene, methylene chloride, methyl ethyl ketone, ethylbenzene, and xylene), pesticides (DDT), and metals (beryllium, cadmium, lead, selenium, zinc, and boron). Chlorinated dioxins may also be present at this location, due to previous detection of dibenzofuran. Also, elevated radiological readings were observed in previous groundwater samples. While those readings may have been indicative of naturally occurring radioisotopes, this could not be confirmed.

Intrusive activities represent greater hazard potentials, and therefore will require more stringent controls. Monitoring instruments capable of detecting volatile emissions (such as a photoionization detector) will be used on a continuous basis, and a radiation survey meter will be used as a screening tool during all subsurface operations. Additionally, the use of dust suppression techniques and more stringent PPE requirements will also be enforced during intrusive activities.

4.2.10 Weapons Center

The primary contaminant of concern at the Weapons Center is cyanide. Secondary substances involve PAHs and chlorinated dioxins. As with other site areas, nonintrusive activities represent lesser hazard potentials than intrusive operations. Therefore, the controls required for the latter will be more stringent than those necessary for the former. These controls will be similar to those previously specified for other (nonradiological) site areas.

Site workers will be made aware that the Weapons Center is a secure area. As a result, any activities performed in this area (especially involving the fenced portion of this area) will have to be done in a manner that conforms to NSB-NLON security requirements. The Base POC identified in this HASP will provide further guidance on these matters prior to the conductance of any site activities.

According to the Base POC, there are no UXO, CWA or other ordnance or energetics concerns in the planned investigation areas of this site.

4.2.11 DRMO

Contaminants of concern (previously detected in soils at this site) include the following:

- Volatile Organics: Vinyl chloride, trichloroethene, and tetrachloroethene.
- Semivolatile Organics: PAHs, PCBs (due to past burning practices at this location, and due to the detection of dibenzofuran in previous soil samples, dioxin formation and presence is also possible).
- Pesticides: DDT, DDD, DDE.
- Metals: Barium, cadmium, chromium, lead, mercury, and silver.

While these contaminants have been primarily detected in the subsurface soil samples, groundwater concerns also are recognized. An additional groundwater concern is that radiological screening levels for gross beta were found to be excessive in two collected groundwater samples. While these readings may have been the result of responses to naturally occurring radioisotopes, contribution by past practices or waste disposal cannot be disregarded without further analysis.

Previous investigatory efforts at this site indicate that these contaminants are in subsurface media (soils and groundwater). Therefore, intrusive operations again present the greatest degree of hazard potentials regarding worker exposures. Controls at this site will involve the following:

- Intrusive Activities:

  - PPE requirements as per Section 6.0.
  - Standard work practices.
  - Continuous monitoring of worker breathing zones.
  - Screening (magnetometer, or similar device) prior to the commencement of drilling or boring operations. Locations where anamolies are detected will be physically marked and avoided.
  - Employment of dust suppression controls.

4.2.12 Lower Submarine Base

Previous investigation efforts at this site have not resulted in the detection of any significant concentrations of contamination. However, some levels of volatile organics and metals were found in groundwater samples, and lead has been detected in the soils. Surficial activities will require only the use of standard field clothes and observance of applicable standard work practices. Intrusive operations will entail controls such as initial and periodic monitoring instrument screening for volatile emissions (in worker breathing zone areas), more stringent levels of PPE, enforcement of appropriate work practices, and the use of dust suppression techniques due to the apparent presence of lead contamination.

4.2.13 Thames River

PAHs and low levels of PCBs have been detected previously in sediment samples taken from the Thames River. Overall, it has been assessed that the potential for site workers to be exposed to hazardous concentrations of contaminants during the planned activities at this site is low. Basically, inhalation threats are not anticipated to be encountered in either vaporous or particulate forms. However, some degree of concern from a dermal exposure route exists. Therefore, workers involved in these activities will be required to wear dermal protection (i.e., at least latex inner gloves) when obtaining or handling samples.

The more significant hazard potential of concern involves that of drowning due to working over and around this body of water. As a result, adherence to requirements (such as those specified by the U.S. Coast Guard [USCG]) for waterway safety will be enforced during these operations. This shall include the use of USCG-approved personal flotation devices for all personnel working in vessels on the river and on the river banks. Also, personnel working on the river banks will utilize lifelines, as appropriate.

Other potential hazard concerns involved in operations planned to be performed at this site are recognized due to the equipment and/or procedures which will be used in these tasks (i.e., electroshocking). Only trained and authorized persons will be permitted to operate this equipment and otherwise support these activities. All unauthorized or unnecessary personnel will be restricted from the area during the performance of these tasks.

The remainder of this section is included to present information in regard to specific chemical and physical hazards associated with the planned activities at NSB/NLON.

4.3 CHEMICAL HAZARDS

The specific chemical hazards which may be encountered in the performance of the planned site activities are presented in Table 4-3. A discussion of those hazards is included in the remainder of this section.

4.3.1 Indicators of Toxic Exposure

The following indicators of toxic exposure are generally observable by others and should be reported to the Site Safety Officer if observed in a worker:

- Changes in complexion, skin discoloration
- Lack of coordination
- Changes in demeanor
- Excessive salivation, pupillary response
- Changes in speech pattern

TABLE 4-3

CHEMICAL CONTAMINANTS OF CONCERN
NSB-NLON
GROTON, CONNECTICUT

Substance	CAS No.	Site(s)	Established Exposure Limits*	Properties and Exposure Symptoms	Routes of Entry and Other Information
Antimony	7440-36-0	• Area A (Landfill, Wetlands, Downstream/OBDA) • DRMO • Goss Cove Landfill • Lower Subase • Rubble Fill at Bunker A-86 • Spent Acid Storage and Disposal Area • Torpedo Shops • CBU Drum Storage • Weapons Center	0.5 mg/m^3 (PEL)	Metal: Silver-white, lustrous, hard, brittle, solid; scale-like crystals; or a dark gray lustrous powder. Irritating to the nose, throat, and mouth. Exposure may result in headache, dizziness, cough, diarrhea, nausea, vomiting, stomach cramps, insomnia, loss of appetite, and olfactory disturbances. Prolonged or repeated exposure may cause damage to the respiratory system, cardio-vascular system, skin and eyes.	Inhalation and contact with skin and eyes
Arsenic	7440-38-2	• Area A (Landfill, Wetlands, Downstream/OBDA) • DRMO • Goss Cove Landfill • Lower Subase • Rubble Fill at Bunker A-86 • Spent Acid Storage and Disposal Area • Torpedo Shops • CBU Drum Storage • Weapons Center	10 μg/m^3 (PEL)	Metal: Silver-gray or tin-white, brittle, odorless solid Exposure may result in ulceration of nasal septum, dermatitis, gastrointestinal disturbances, respiratory irritation, hyperpigmentation of the skin, and disease of the nervous system. Prolonged or repeated exposure may result in damage to the liver, kidneys, skin, lungs, and lymphatic system.	Inhalation, absorption, ingestion, and contact with the skin and eyes NOTE: Arsenic is listed as a carcinogen by OSHA
Barium	7440-39-3	• Area A (Landfill, Wetlands, Downstream/OBDA) • DRMO • Goss Cove Landfill • Lower Subase • Rubble Fill at Bunker A-86 • Spent Acid Storage and Disposal Area • Torpedo Shops • CBU Drum Storage • Weapons Center	0.5 mg/m^3 (TLV)	Metal: Silver-white, slightly lustrous, malleable solid. Exposure may result in upper respiratory tract irritation, abdominal disturbances, muscle spasms, slow pulse, premature contractions of the heart, irritation to the skin and eyes, and skin burns. Prolonged or repeated exposure may result in damage to the heart, central nervous system, respiratory system, and eyes.	Inhalation, ingestion, and contact with the skin and eyes.

TABLE 4-3
CHEMICAL CONTAMINANTS OF CONCERN
NSB-NLON
GROTON, CONNECTICUT
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Substance	CAS No.	Site(s)	Established Exposure Limits*	Properties and Exposure Symptoms	Routes of Entry and Other Information
Benzene	71-43-2	• Area A (Landfill, Wetland, and Downstream/OBDA) • Goss Cove Landfill • Lower Subase • Torpedo Shops	0.1 ppm (TLV) 0.1 ppm (REL) 1 ppm (ceiling limit)	Colorless to light-yellow liquid with an aromatic odor. Irritating to the eyes, nose and respiratory system. Exposure may result in giddiness, headache, staggered gait, fatigue, dermatitis dizziness, coma and death. Repeated or long term exposure may result in loss of weight, weakness, and damage to the blood forming system (bone marrow).	Inhalation, absorption, ingestion, and contact with the skin and eyes NOTE: Benzene is listed as a carcinogen by IARC, NTP, OSHA and is listed as a confirmed human carcinogen (Group A1) by the ACGIH.
Beryllium	7440-41-7	• Area A (Landfill, Wetlands, Downstream/OBDA) • DRMO • Goss Cove Landfill • Lower Subase • Rubble Fill at Bunker A-86 • Spent Acid Storage and Disposal Area • Torpedo Shops • CBU Drum Storage • Weapons Center	2 $\mu g/m^3$ (PEL) 5 $\mu g/m^3$ (ceiling)	Metal: a hard, brittle, gray-white solid. Exposure may result in weakness, fatigue, weight loss and respiratory ailments Prolonged or repeated exposure may result in damage to the lungs, skin, eyes, and mucous membranes.	Inhalation NOTE: Beryllium is listed as a carcinogen by OSHA, NTP Annual Report on Carcinogens, IARC (Group 1, 2A, 2B) carcinogens and EPA Carcinogen Assessment Group
Cadmium	7440-43-9	• Area A (Landfill, Wetlands, Downstream/OBDA) • DRMO • Goss Cove Landfill • Lower Subase • Rubble Fill at Bunker A-86 • Spent Acid Storage and Disposal Area • Torpedo Shops • CBU Drum Storage • Weapons Center	0.05 mg/m^3 (TLV)	Metal: Silver-white, blue-tinged, lustrous, odorless solid Exposure may result in pulmonary edema, cough, tightness in the chest, substernal pain, difficulty breathing, headache, chills, muscle aches, nausea, vomiting, diarrhea, loss of sense of smell, presence of protein in the urine, and mild anemia. Prolonged or repeated exposure may result in damage to the respiratory system, kidneys, prostrate and blood.	Inhalation and ingestion NOTE: Cadmium is listed as a carcinogen by OSHA, and IARC GROUP 1, 2A, 2B carcinogens

TABLE 4-3
CHEMICAL CONTAMINANTS OF CONCERN
NSB-NLON
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Substance	CAS No.	Site(s)	Established Exposure Limits*	Properties and Exposure Symptoms	Routes of Entry and Other Information
Chromium	7440-47-3	• Area A (Landfill, Wetlands, Downstream/OBDA) • DRMO • Goss Cove Landfill • Lower Subase • Rubble Fill at Bunker A-86 • Spent Acid Storage and Disposal Area • Torpedo Shops • CBU Drum Storage • Weapons Center	0.5 mg/m^3 (TLV)	Blue-white to steel-gray, lustrous, brittle, hard solid. Exposure may result in histologic fibrosis of the lungs. Prolonged or repeated exposure may result in progressive fibrosis of the lungs.	Inhalation and ingestion
Copper	7440-50-8	• Area A (Landfill, Wetlands, Downstream/OBDA) • DRMO • Goss Cove Landfill • Lower Subase • Rubble Fill at Bunker A-86 • Spent Acid Storage and Disposal Area • Torpedo Shops • CBU Drum Storage • Weapons Center	1 mg/m^3 (TLV)	Metal: reddish, lustrous, malleable, odorless solid Irritating to the mucous membranes and pharynx. exposure may result in nasal perforation, eye irritation, metallic taste, dermatitis. Copper exposure to laboratory animals has indicated lung, liver and kidney damage and anemia. Prolonged or repeated exposure may result in damage to the respiratory system, liver, kidneys, and an increased risk of Wilson's Disease.	Inhalation, ingestion, and contact with the skin and eyes
Cyanide	57-12-5	• Area A (Landfill, Wetlands, Downstream/OBDA) • DRMO • Goss Cove Landfill • Lower Subase • Rubble Fill at Bunker A-86 • Spent Acid Storage and Disposal Area • Torpedo Shops • CBU Drum Storage • Weapons Center	5 mg/m^3 (PEL)	Appearance varies with compounds. Asphyxiation and death can occur with exposure. Symptoms may include; weakness, headache, confusion, nausea, vomiting, slow gasping respirations irritation to the eyes and skin. Prolonged or repeated exposure may result in damage to the cardiovascular system, central nervous system, liver, kidneys, and skin.	Inhalation, ingestion, and contact with skin and eyes

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Substance	CAS No.	Site(s)	Established Exposure Limits*	Properties and Exposure Symptoms	Routes of Entry and Other Information
1,1-dichloroethane	75-34-3	• Area A (Landfill, Wetland, and Downstream/OBDA) • DRMO • Goss Cove Landfill • Torpedo Shops • OBDANE • Rubble Fill Area at Bunker A-86	100 ppm (TLV)	Colorless, oily liquid with a chloroform-like odor. Exposure may result in central nervous system depression, skin irritation and damage to the liver and kidneys. Prolonged or repeated exposure may result in damage to the skin, liver and kidneys.	Inhalation, ingestion, and contact with the skin and eyes.
1,2-dichlorethene	540-59-0	• Area A (Landfill, Wetland, and Downstream/OBDA) • DRMO • Goss Cove Landfill • Torpedo Shops • OBDANE • Rubble Fill Area at Bunker A-86	200 ppm (PEL)	Colorless liquid with a slightly acrid, chloroform-like odor. Irritating to the eyes, and respiratory system. Exposure may result in central nervous system depression. Prolonged or repeated expsoure may result in damage to the respiratory system, eyes, and central nervous system.	Inhalation, ingestion, and contact with the skin and eyes.
Ethylbenzene	100-41-4	• Area A (Landfill, Wetland, and Downstream/OBDA) • Goss Cove Landfill • Lower Subase • Torpedo Shops	100 ppm (PEL) 125 ppm (STEL)	Colorless liquid with an aromatic odor Irritating to the eyes and mucous membranes. Exposure may result in headache, dizziness, dermatitis, narcosis, and coma. Prolonged or repeated exposure may result in damage to the respiratory system, eyes and skin.	Inhalation, ingestion, and contact with skin and eyes
Lead	7439-92-1	• Area A (Landfill, Wetlands, Downstream/OBDA) • DRMO • Goss Cove Landfill • Lower Subase • Rubble Fill at Bunker A-86 • Spent Acid Storage and Disposal Area • Torpedo Shops • CBU Drum Storage • Weapons Center	50 $\mu g/m^3$ (PEL) 0.15 mg/m^3 (TLV)	Metal: a heavy ductile, soft, gray solid. Exposure may result in weakness, insomnia, malnutrition, pallor, constipation, abdominal pain, colic, anemia, gingival lead line, tremors, hypotension, stiffness in the ankle and wrist joints, irritation to the eyes, damage to the brain in the from of various diseases, and kidney disease. Prolonged or repeated exposure may result in damage to the gastrointestinal tract, central nervous system, kidneys, blood, and brain.	Inhalation, ingestion, and contact with the skin and eyes

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Substance	CAS No.	Site(s)	Established Exposure Limits*	Properties and Exposure Symptoms	Routes of Entry and Other Information
Mercury	7439-97-6	• Area A (Landfill, Wetlands, Downstream/OBDA) • DRMO • Goss Cove Landfill • Lower Subase • Rubble Fill at Bunker A-86 • Spent Acid Storage and Disposal Area • Torpedo Shops • CBU Drum Storage • Weapons Center	0.05 mg/m³ (PEL)	Silver-white, heavy, odorless, liquid. Exposure may result in cough, chest pain, difficulty breathing, bronchitis pneumonitis, tremor, insomnia, indecision, headache, fatigue, weakness, stomatitis, profuse salivating, gastrointestinal disturbances, anorexia, irritation of the eyes and skin. Prolonged or repeated exposure may result in damage to the skin, respiratory system, central nervous system,kidneys, and eyes.	Inhalation, absorption, and contact with the skin and eyes
Methylene Chloride	75-09-2	• Area A (Wetlands, and OBDA)	50 ppm (TLV)	Colorless liquid with a chloroform-like odor. Exposure may result in fatigue, weakness, sleepiness, numbness in the limbs, tingling sensation, nausea, irritation to the eyes and skin. Prolonged or repeated exposure may result in damage to the skin, eyes, central nervous system, and cardio- vascular system.	Inhalation, ingestion, and contact with the skin and eyes. NOTE: Methylene Chloride is listed a carcinogen by the NTP Annual Report on carcinogens, IARC Group 1, 2A, 2B carcinogenic substances and the ACGIH Group A2.
Methyl Ethyl Ketone (2-Butanone)	78-93-3	• Area A (Landfill, Wetland, and Downstream/OBDA) • DRMO • Goss Cove Landfill • Torpedo Shops • OBDANE • Rubble Fill Area at Bunker A-86	200 ppm (PEL) 300 ppm (STEL)	Colorless liquid with a moderately sharp, fragrant, mint- or acetone-like odor. Exposure may result in irritation to the eyes and nose, headache, dizziness, and vomiting Prolonged or repeated exposure may result in damage to the central nervous system and lungs.	Inhalation, ingestion, and contact with the skin and eyes.

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Substance	CAS No.	Site(s)	Established Exposure Limits*	Properties and Exposure Symptoms	Routes of Entry and Other Information
Pesticides (DDT and residuals)	50-29-3 (for DDT)	• Area A (Landfill, Wetlands, Downstream/OBDA) • DRMO • Goss Cove Landfill • CBU Drum Storage • Rubble Fill Area at Bunker A-86 • Torpedo Shops	0.5 mg/m³ (REL) 1.0 mg/m³ (PEL)	Colorless crystals or off-white powder with an intense, bitter, chocolate-like odor. Exposure may result in a burning, pricking, or numbness of the tongue, lips, face, and hands, tremor, apprehension, dizziness, confusion, malaise, headache, fatigue, convulsions, paralysis of the hands, vomiting, irritation of the eyes and skin. Prolonged or repeated exposure may result in damage to the central nervous system, kidneys, liver, skin, and peripheral nervous system.	Inhalation, ingestion, absorption, and contact with the skin and eyes
Polyaromatic Hydrocarbons (PAHs)-Naphthalene	varies 91-20-3 (for naphthalene)	• Area A (Landfill, Wetlands) • DRMO • Goss Cove Landfill • Rubble Fill Area at Bunker A-86 • Weapons Center • Thames River	10 ppm (PEL)* 15 ppm (STEL)* (*) Exposure limits for Naphthalene	Colorless to brown solid with an odor or mothballs. Exposure may result in irritation to the eyes, headache, confusion, nausea, vomiting, abdominal pain, irritation of the bladder, profuse sweating, renal shutdown, dermatitis, jaundice, hemoglobinuria. Prolonged or repeated exposure may result in damage to the eyes, blood, liver, kidneys, skin, red blood cells, and central nervous system.	Inhalation, absorption, ingestion, and contact with skin and eyes
Polychlorinated Biphenyls (PCBs)	11097-69-1 53469-21-9	• Area A (Landfill) • DRMO • Goss Cove Landfill • Torpedo Shops • Thames River	0.5 mg/m³ (TLV)	Viscous liquid of varying color with a mild hydrocarbon odor. Exposure may result in irritation to the eyes and skin, hyperpigmentation of the skin and mucous membrane, chloracne, fever, hearing difficulties, limb spasms, headache, vomiting, and diarrhea. Prolonged or repeated exposure may result in damage to the skin eyes and liver.	Inhalation, ingestion, absorption, and contact with the skin and eyes

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Substance	CAS No.	Site(s)	Established Exposure Limits*	Properties and Exposure Symptoms	Routes of Entry and Other Information
Radiological Agents (alpha, beta, and gamma)		• Area A (Landfill, Downstream/OBDA) • Goss Cove Landfill • DRMO	Varies by type of radiation (alpha, beta, gamma), isotope, and activity of radiological agent.	Varies by type of radiation, route of exposure, isotope, and activity of radiological agent. In addition, symptoms of exposure will be dependent upon the extent of exposure, which in turn will be dependent upon the duration of exposure, distance from radiological source, and type and amount of shielding that may have been used.	Inhalation, ingestion, contact with skin and eyes, and absorption.
Selenium	7782-49-2	• Area A (Landfill, Wetlands, Downstream/OBDA) • DRMO • Goss Cove Landfill • Lower Subase • Rubble Fill at Bunker A-86 • Spent Acid Storage and Disposal Area • Torpedo Shops • CBU Drum Storage • Weapons Center	0.2 mg/m³ (PEL)	Amorphous or crystalline, red to gray solid. Irritating to the eyes, nose, and throat. Exposure may result in vision distortion, headache, chills, fever, difficulty breathing, bronchitis, metallic taste, gastrointestinal disturbances, dermatitis, skin and eye burns. Selenium exposure to laboratory animals has resulted in anemia and damage to the liver and kidneys. Prolonged or repeated exposure may result in damage to the upper respiratory tract, eyes, skin, liver blood and kidneys.	Inhalation, ingestion, and contact with the skin and eyes
Silver	7440-22-4	• Area A (Landfill, Wetlands, Downstream/OBDA) • DRMO • Goss Cove Landfill • Lower Subase • Rubble Fill at Bunker A-86 • Spent Acid Storage and Disposal Area • Torpedo Shops • CBU Drum Storage • Weapons Center	0.01 mg/m³ (PEL)	Metal: white,lustrous, solid. Exposure may result in blue-gray eyes, nasal septum, skin and throat irritation, ulceration and gastrointestinal disturbances. Prolonged or repeated exposure may result in permanent damage to the skin, eyes and nasal septum.	Inhalation, ingestion, and contact with the skin and eyes

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Substance	CAS No.	Site(s)	Established Exposure Limits*	Properties and Exposure Symptoms	Routes of Entry and Other Information
TCDD-Dioxin	1746-01-6	• Area A (Landfill, Downstream/OBDA) • Goss Cove Landfill • Weapons Center • DRMO	None established	Exposure may result in irritation to the eyes, skin, and respiratory tract, chloracne, hyperpigmentation, disorders of the respiratory and urinary tracts, nausea, vomiting, muscle aches, sensorial impairments (sight, hearing, smell), weakness, lassitude, impotence and loss of libido. Prolonged or repeated exposure may result in damage to the liver, cardiovascular system, and pancreas.	Inhalation, absorption, ingestion, and contact with the skin and eyes
Tetrachloroethene	127-18-4	• Area A (Landfill, Wetland, and Downstream/OBDA) • DRMO • Goss Cove Landfill • Torpedo Shops • OBDANE • Rubble Fill Area at Bunker A-86	25 ppm (TLV) 100 ppm (STEL)	Colorless liquid with a mild, chloroform-like odor. Exposure may result in irritation to the eyes, nose, throat, nausea, flushed face and neck, vertigo, dizziness, headache, incoordination, drowsiness, reddening of the skin and damage to the liver. Prolonged or repeated exposure may cause damage to the liver, kidneys, eyes, upper reparatory system, and the central nervous system.	Inhalation, ingestion, and contact with the skin and eyes. NOTE: Tetrachloroethylene is listed as a carcinogen by the NTP Annual Report on Carcinogens, IARC (Group 1, 2A, 2B carcinogens and the ACGIH Group A3.
Toluene	108-88-3	• Area A (Landfill, Wetland, and Downstream/OBDA) • Goss Cove Landfill • Lower Subase • Torpedo Shops	50 ppm (TLV)	Colorless liquid with a sweet, pungent, benzene-like odor. Exposure may result in fatigue,, weakness, euphoria, dizziness, headache, dilated pupils, confusion, nervousness, muscle fatigue, insomnia, dermatitis, tearing of the eyes, and sensation of numbness or burning. Prolonged or repeated exposure may result in damage to the central nervous system, liver, kidneys and skin.	Inhalation, absorption, ingestion, and contact with the skin and eyes.

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Substance	CAS No.	Site(s)	Established Exposure Limits*	Properties and Exposure Symptoms	Routes of Entry and Other Information
Trichloroethane	79-00-5, 71-55-6	• Area A (Landfill, Wetland, and Downstream/OBDA) • DRMO • Goss Cove Landfill • Torpedo Shops • OBDANE • Rubble Fill Area at Bunker A-86	10 ppm (PEL)	Colorless liquid with a sweet, chloroform-like odor. Exposure may result in irritation to the eyes and nose, central nervous system depression and damage to the liver and kidneys. Prolonged or repeated exposure may result in damage to the central nervous system, eyes, nose, and kidneys.	Inhalation, absorption, ingestion and contact with the skin and eyes. NOTE: Trichloroethane is listed as a carcinogen by IARC (Group 3,4 substances).
Trichloroethene	79-01-6	• Area A (Landfill, Wetland, and Downstream/OBDA) • DRMO • Goss Cove Landfill • Torpedo Shops • OBDANE • Rubble Fill Area at Bunker A-86	50 ppm (TLV) 100 ppm (STEL)	Colorless liquid (unless dyed blue) with a chloroform-like odor. Exposure may result in headache, vertigo, visual disturbances, drowsiness, nausea, vomiting, tremors, irritation to the eyes, dermatitis and cardiac arrhythmia. Prolonged or repeated exposure may result in damage to the respiratory system, heart, liver, kidney, central nervous system, and skin.	Inhalation, ingestion, and contact with the skin and eyes. NOTE: Trichloroethene is listed as a carcinogen by IARC (Group 3,4 substances) and by NIOSH.
Vinyl Chloride	75-01-4	• Goss Cove Landfill • DRMO	1 ppm (PEL) 5 ppm (STEL)	Colorless gas or liquid (below 56°F) with a pleasant odor at high concentrations. Exposure may result in weakness, abdominal pain, gastrointestinal bleeding, pallor of cyan of extremities, enlargement of the liver. Prolonged or repeated exposure may result in damage to the liver, central nervous system, blood, respiratory system, and lymphatic system.	Inhalation NOTE: Vinyl chloride is listed as a carcinogen by the NTP Annual Report on Carcinogens, IARC Group 1, 2A, 2B carcinogens, EPA Carcinogen Assessment Group, OSHA, and the ACGIH Confirmed Human Carcinogen.

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Substance	CAS No.	Site(s)	Established Exposure Limits*	Properties and Exposure Symptoms	Routes of Entry and Other Information
Xylenes	1330-20-7, 95-47-6, 108-38-3, 106-42-3	• Area A (Landfill, Wetland, and Downstream/OBDA) • Goss Cove Landfill • Lower Subase • Torpedo Shops	100 ppm (PEL) 150 ppm (STEL)	Colorless liquids with an aromatic odor. Exposure may result in dizziness, excitement followed by drowsiness, staggering gait, irritation of the nose and throat, nausea, vomiting, abdominal pain and dermatitis. Repeated or prolonged exposure may result in olfactory changes, and damage to the gastrointestinal tract, blood, heart, liver, kidneys, nervous system, and skin.	Inhalation, absorption, ingestion, and contact with the skin and eyes.

* Established Exposure Limits are specified as 8-hour time-weighted average concentrations, unless otherwise specified.
CAS NO.: Chemical Abstracts Services substance identification number
TLV: American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values, 1992-1993
REL: National Institute of Occupantional Safety and Health Recommended Exposure Limit
STEL: ACGIH Short Term Exposure Limit
ppm: Volumes of substance per million volumes of air
mg/m^3: Milligrams of substance per cubic meter of air
$\mu g/m^3$: Micrograms of substance per cubic meter of air

The following symptoms of toxic exposure are generally non-observable by others, and should be reported to the Site Safety Officer if experienced:

- Headaches
- Dizziness
- Blurred vision
- Cramps
- Irritation of eyes, skin, or respiratory tract.

4.4 PHYSICAL HAZARDS

In addition to the chemical hazards presented above, certain physical hazards may also be encountered in the performance of planned activities. The most significant of these hazards include:

- The potential for a worker to become struck by or entangled in operating items of heavy machinery (i.e., rotting auger flytes).
- Injury due to improper manual material handling.
- Overexposure to noise.
- Contact with underground and/or overhead utilities.
- Uneven/unstable walking and working surfaces.
- Cold stress.
- Heat stress.
- Threat of drowning during operations performed over or near bodies of water
- Other physical hazards.

Control measures concerning physical hazards as applicable for task specific activities will apply for both intrusive and non intrusive activities.

4.4.1 Heavy Machinery

Several of the tasks that will be performed at the site involve the use of heavy machinery. The most notable is the use of drill rigs in subsurface activities. The potential exists for workers to be struck by or to become entangled in machinery during such tasks. Control measures for these hazards are presented in Section 7.0 "Standard Work Practices." Inspection of all heavy equipment will be conducted initially, then periodically to ensure all emergency devices operate properly and all snag points are removed.

4.4.2 Manual Material Handling

The potential exists for workers to be injured while lifting heavy objects and/or pieces of equipment. If objects are improperly lifted, debilitating back strain and/or other injuries can result. Proper lifting and carrying techniques will be reviewed by the SSO and enforced throughout site activities.

4.4.3 Overexposure to Noise

Since many of the tasks to be performed require the use of items of heavy machinery, workers have the potential to be exposed to noise in excess of the OSHA Permissible Exposure Limit (85 decibels on the A-weighted scale). Depending on the level and duration of exposure, excessive noise exposure can cause permanent hearing loss. At the discretion of the SSO, noise monitoring may be performed to evaluate this potential hazard. However, as a precautionary measure, appropriate items of hearing protection will maintained on site available to all personnel, and required for use during all heavy equipment operations until an evaluation is performed.

4.4.4 Contact with Underground/Overhead Utilities

During subsurface activities such as drilling and test boring, the potential to encounter underground energized utilities (i.e., gas and electric lines) exist. Any areas identified for such subsurface activities must first be cleared of underground utilities. This clearance shall include locating the utilities, and physically marking and avoiding those locations by the FOL.

A second potential threat in this subject area involves contact with overhead energized electrical lines. Drilling locations shall be selected so that the mast of the rig is at least beyond a 20-foot radius of any overhead power lines.

Finally, a third related operation of concern involves the use of electrical equipment during water operations in the ecological sampling task (i.e., electroshocking operations). This also presents shocking-electrocution hazards. In the performance of these activities, only trained and experienced operators will be permitted to utilize the equipment, the equipment shall be operated in accordance with its manufacturer's recommendations, and all unnecessary and/or unauthorized personnel will be restricted from the area.

4.4.5 Uneven Walking/Working Surfaces

Operations performed in areas where these types of conditions exist present the potential for slip and fall hazards. This is historically one of the most common causes of worker injury in the United States. These types of conditions can cause workers to loose their footing, which can result in strained muscles, sprained ligaments, cuts and/or abrasions, or more serious injuries (i.e., if moving or operating machinery is in the immediate area, if over or near water, etc.). Workers will be made aware of these hazards as they move from area to area and avoid such areas as much as possible.

In order to control these hazards, the Standard Work Practices specified in Section 7.0 of this HASP (as well as the other requirements stated in this document) will be implemented and enforced throughout site operations.

4.4.6 Cold Stress

As this work involves outdoor activities, there is the potential for workers to be exposed to cold stress environments (depending on ambient atmospheric conditions during the performance of planned activities). Cold stress is defined as the stress resulting from the net heat loss on the body or the net heat loss on a portion of the body such as feet, hands, limbs, or head. Areas of the body most susceptible to injury due to cold stress involve those areas with a high surface area-to-mass ratio (such as fingers, toes, nose, ears, etc.). Physiological conditions that are characteristic of exposure to a cold environment include; intense sympathetic nerve stimulation (shivering), vasoconstriction, increased oxygen consumption, accelerated respiration and pulse, elevated blood pressure, and significant increase in cardiac output.

Hypothermia, which is defined as an abnormal lowering of the deep body core temperature, is a serious life threat which may be present for workers assigned to work under cold environmental conditions. This is of particular concern for operations such as the ecological sampling which will be performed over or near bodies of water. In a cold environment, if a worker should be splashed or become immersed in water, the threat of cold stress to this degree would be significant. This is based on the ability of water to conduct heat (or the lack of it) over 200 times faster than air. This situation can dramatically and quickly lower the individual's body temperature. Lower body temperatures can result in reduced mental alertness, reduction in rational decision making, loss of consciousness and possible death.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering develops when the body temperature has fallen to 95°F. This should be taken as a sign of danger and exposure to cold should be immediately terminated.

If cold ambient temperatures are anticipated or encountered (e.g., 40°F or less), workers should implement the use of thermal underclothing. The practice of using several layers of loose-fitting clothing as opposed to a single layer of heavy and/or restrictive clothing is preferred for protection against exposure to cold stress. In addition, other controls (such as warm-up periods in heated areas) may be instituted if colder environments are encountered, to further limit exposure to the cold.

Two factors influence the development of a cold injury: ambient temperature and the velocity of the wind. Wind chill is used to describe the chilling effect of moving air in combination with low temperature. For instance, 10°F with a wind of 15 miles per hour (mph) is equivalent in chilling effect to still air at -18°F.

As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, as previously indicated, water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical-protective equipment is removed if the clothing underneath is perspiration-soaked.

Local injury resulting from cold is included in the generic term frostbite. There are several degrees of damage. Frostbite of the extremities can be categorized into:

- <u>Frost Nip or Incipient Frostbite</u>: Characterized by sudden blanching or whitening of the skin.

- <u>Superficial Frostbite</u>: Skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.

- <u>Deep Frostbite</u>: Tissues are cold, pale, and solid; extremely serious injury.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. Its symptoms are usually exhibited in five stages:

- Shivering.
- Apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F.
- Unconsciousness, glassy stare, slow pulse, and slow respiratory rate.
- Freezing of the extremities.
- Death.

Standard reference books should be consulted for specific first aid treatments. Medical help must be obtained for the more serious conditions. Additional information on the concepts of cold stress recognition, evaluation, and control is provided in Appendix III of this HASP.

4.4.7 Heat Stress

Wearing personal protective equipment puts site workers at risk of developing heat stress. Heat stress may result in health effects ranging from fatigue to serious illness to death. This condition is caused by the interplay characteristics of each worker. The major symptoms of heat stress are listed in Table 4-4. Worker monitoring for heat stress will be performed at the discretion of the SSO. However, as a standard operating procedure, when the temperature in the work area is at or above 70°F (21°C), workers will be monitored for heat stress during rest periods according one of the following procedures:

- Take pulse over a 30-second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest time the same. If, at the next rest period, the heart rate still exceeds 110 beats per minute, shorten the following work period again by one-third. Continue the process as necessary.

- Take body temperature orally using a clinical thermometer kept under the tongue for 3 minutes. Take temperature at the end of each work cycle before drinking anything. If the temperature exceeds 99.6°F (37.6°C), shorten the next work period by one third without changing the rest period. If the temperature still exceeds 99.6°F at the beginning of the next rest period, shorten the following work cycle by one-third. No worker will be permitted to wear a semi-permeable or impermeable garment if their temperature exceeds 100.6°F (38.1°C).

- Another method is to monitor worker's total body water loss. Body water loss is determined by weighing each worker, on a scale accurate to within 0.25 pounds, at the beginning and end of each day. The difference in weights will indicate whether an individual is drinking enough fluids to prevent dehydration. The body weight loss should not exceed 1.5 percent of the total body weight in one work day. However, there are limitations to using this method. For example, perspiration-soaked clothing can mask true body water loss. Therefore, for this

TABLE 4-4

SIGNS AND SYMPTOMS OF HEAT STRESS

Heat rash may result from continuous exposure to heat or humid air.
Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include: • Muscle spasms • Pain in the hands, feet and abdomen
Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include: • Pale, cool, moist skin • Heavy sweating • Dizziness • Nausea • Fainting
Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are: • Red, hot, usually dry skin • Lack of or reduced perspiration • Nausea • Dizziness and confusion • Strong, rapid pulse • Coma

method to be accurate, weighing must be done with clothing removed (to the extent possible). Also, this method typically can be employed only at the end of the work day (due to disrobing needs, as mentioned above, and involved time factors). This limits the effectiveness of this method in monitoring worker heat stress during the work period. Additional information on heat stress recognition, evaluation, and control is provided in Appendix III of this HASP.

4.4.7 Drowning

As previously discussed, potentials for drowning incidents exist for water operations such as those planned in the ecological sampling task. To control this threat, applicable regulations and safe practices (such as those specified by the USCG) shall be enforced.

4.4.8 Other Physical Hazards

Additional physical hazards are presented below.

4.4.8.1 Precautions for Contact with Buried Compressed Gas Cylinders, Ordnance, or Other Items

Based on information provided by the Base POC, containers such as compressed gas cylinders have been encountered during previous excavation operations at the Goss Cove Landfill. The POC also has stated that these types of containers may also exist at the Area A Landfill, due to past landfill disposal activities. All areas where it is reasonable to assume that such activities may have occurred, and where subsurface operations are planned, will undergo a prior thorough magnetometer screening. Any locations where anomalies are detected in this process will be clearly marked and avoided.

4.4.8.2 Precautions for Confined Entry Work

The planned activities do not involve the potential for the performance of any confined space entry work. No personnel are authorized to perform any operations of this nature.

4.4.8.3 Lyme Disease

Due to the geographical location of this site and the planned time of year that site activities are scheduled to commence, the potential for site workers to encounter ticks infected with Lyme disease exists. Ticks have been recognized as the primary vector for the transmission of this disease. Appendix II is included with this HASP to provide additional information on this subject.

Personnel will be advised to perform close personal inspections to detect and remove any ticks upon leaving any site areas. This will be particularly emphasized while working in heavily-vegetated site areas.

4.4.8.4 Ionizing Radiation

Previous sample results from the Goss Cove Landfill, the Area A Landfill, the Area A Downstream/OBDA, and the DRMO sites have shown elevated levels of radiation in the groundwater. These readings may have been the result of naturally-occurring radioisotopes, however,it has been determined that further analyses are required to verify this assumption. Previous radiation surveys conducted at each of these locations did not report any readings above background. As a precaution for the safety of the employees performing work on these sites, radiological screening will be performed.

5.0 AIR MONITORING

This section presents requirements for the use of real-time air monitoring instruments during site activities involving the potential for exposure to site contaminants. It establishes the types of instruments to be used, the frequency of which they are to be used, techniques for their use, action levels for upgrading/downgrading levels of protection, and methods for instrument maintenance and calibration.

It should be noted that many of the contaminants are not detectable through the use of real-time monitoring instrumentation. For those particulate or particulate-bound contaminants, engineering efforts will be employed to control potential exposure. The more volatile substances which may bypass this effort can be detected and quantified by employing the following instruments in a coordinated effort to characterize potential exposure and to validate control measures.

5.1 INSTRUMENTS AND USE

An HNu PI-101 equipped with an 11.7 electron volt (eV) lamp will be used to detect the presence or absence of airborne inorganic and organic chemical gases and vapor emissions, based on their ionization potential. Draeger (colorimetric) tubes will be employed in conjunction with the HNU PI-101 to confirm or deny the presence of specific contaminants of concern (e.g., benzene, methylene chloride, vinyl chloride). Additionally, an LEL/O_2 meter will used during subsurface investigation activities to detect the presence of flammable/explosive and/or oxygen deficient atmospheres. Lastly, radiation survey meters equipped with probes sensitive to alpha, and probes sensitive to beta and gamma radiation will be used. The frequency of use of these instruments (e.g. initial, periodic, continuous) is presented for each site area in Table 5-1.

5.2 AIR MONITORING REQUIREMENTS - PARTICULATE EMISSIONS

As presented in Section 4.0 of this HASP, Hazard Assessment, several of the contaminants of concern identified for the sites and planned activities are of a concern in regard to inhaling particulate emissions. This may occur due to the substance being in the physical form of a solid under ambient conditions (such as numerous types of pesticides), or as the result of contaminant-ladened particulates (such as PCBs, dioxin, or lead-ladened dust particulates). It is intended that these potential hazards will be controlled through the effective use of engineering controls, such as dust suppression techniques, as stipulated above. Water spray will be used prior to the initiation (and periodically thereafter, as necessary) of any intrusive work at

TABLE 5-1

MONITORING INSTRUMENTS AND FREQUENCY OF USE
NSB-NLON
GROTON, CONNECTICUT

Site	HNU with 11.7-eV Probe				Draeger Tube	Micro-R Meter	LEL/O_2 Meter
	Intrusive Work			Non-Intrusive Work	Intrusive and Non-Intrusive	Intrusive and Non-Intrusive	Intrusive
	Initial	Periodic	Continuous	Initial and Periodic	*See Note	Initial and Periodic	Initial and Periodic
CBU Drum Storage Area	X	X		X	*See Note		X
OBDANE	X	X		X	*See Note		X
Bunker A-86	X	X		X	*See Note		X
Torpedo Shops			X	X	*See Note		X
Goss Cove Landfill			X	X	*See Note	X	X
Spent Acid Storage and Disposal Area	X	X		X	*See Note		X
Area A Landfill			X	X	*See Note	X	X
Area A Wetlands			X	X	*See Note		X
Area A Downstream and OBDA			X	X	*See Note	X	X
Weapons Center	X	X		X	*See Note		X
DRMO			X	X	*See Note	X	X
Lower Subase	X	X		X	*See Note		X
Thames River					*See Note		

Note: If at any time a positive reading is indicated, monitoring will be performed more frequently. In addition, if area monitoring reveals a positive reading, the worker's breathing zone monitoring will be conducted.
The frequency of Draeger tube monitoring will be dependent on concentrations detected with the PID.

sites where these types of hazards may be encountered. Locations where these practices will be used are identified in Section 4.0 of this HASP. In observing this requirement, no specific air monitoring needs will be necessary.

5.3 AIR MONITORING REQUIREMENTS - GAS AND VAPORS

Air monitoring with a photoionization detector (PID) such as an HNU Model PI-101 equipped with an 11.7-eV probe will be initiated at potential sources of vapor emissions. This monitoring will be performed with an emphasis on monitoring workers' breathing zone areas.

Any sustained readings above established background levels in the workers' breathing zones will require immediate retreat to an unaffected area, and the work area will be allowed to ventilate. Work may resume without respiratory protection only when background levels are regained. At site areas where potential inhalation threats consist predominantly in the form of particulates, or gaseous contaminants where air-purifying respiratory protection is appropriate (i.e., excluding areas were the substances methylene chloride and vinyl chloride are of concern) work may continue with the use of full-face respirators equipped with combination organic vapor/HEPA filter cartridges up to PID readings of 5 ppm (in worker's breathing zones). Above that level, work can continue only in Level B (air supplied respiratory protection). In areas where methylene chloride or vinyl chloride may reasonably be encountered, any sustained breathing zone readings will warrant the immediate evacuation of the area, with work resuming only when background levels are regained or in Level B protection. The use of air purifying respirators is inappropriate unless the presence of these substances can be positively ruled out (i.e., through the use of colorimetric tube analysis).

Draeger tubes shall be employed in conjunction with the HNu as part of the air monitoring program supporting site activities. This approach has been specified in order to meet the requirements of 29 CFR 1910.120 (h) which states that efforts must be taken to determine the identity and quantity of potential site contaminants. The use of the HNu in the survey mode of operation will not identify airborne substances, only detect them at very low levels. However, the use of the Draeger tubes in conjunction with these instruments permits a semi-quantitative result with positive identification within the restrictions of the limitations of the instrument.

The effective use of these tubes (in accordance with the manufacturer's specifications, which vary for each type of tube), and appropriate timely response if a color change is observed, will effectively minimize the potential for workers to be overexposed to suspected site contaminants. Colorimetric tubes for benzene (0.5/c specific), methylene chloride (100/a), and vinyl chloride (0.5/a) will be utilized any time readings above background are obtained and sustained (1 minute) in the breathing zone.

Where positive results are obtained, personnel must immediately cease operations in the area, retreat to an unaffected area, and await further instruction from the Halliburton NUS Project Manager and the NAVY CLEAN HSM.

Long-term tubes for these contaminants may be employed as personal samplers, should the need arise to characterize exposure based on real-time monitoring instrument results.

5.4 AIR MONITORING REQUIREMENTS - LEL/O_2

Air monitoring with the LEL/O_2 meters will be conducted during all subsurface activities. If elevated LEL/O_2 readings are observed at the source (i.e., equal to or greater than 10%), workers must be advised of the potential explosive nature of the environment and must immediately discontinue spark generating activities (i.e., deactivate engines, use only tools that are spark resistant, etc.), and attempts must be made to ensue proper PPE (specifically in regard to respiratory protection) are effected. LEL readings in excess of 20% requires cessation of all activities and to retreat to an unaffected area. Work will not be permitted to resume until readings subside. Under no circumstances will work be permitted to be performed in oxygen deficient (<19.5% oxygen) or oxygen enriched (>25%) atmospheres.

5.5 RADIOLOGICAL SCREENING

Radiological screening will be performed initially at all site areas as a precautionary measure, and more frequently at areas where evidence or information suggests that this may be of concern. These areas are presented in Section 4.0 of this HASP. In addition to real-time monitoring with radiation survey meters, all Halliburton NUS personnel will also wear their assigned thermoluminescent dosimetry (TLD) badge while on site.

Several site areas involved in the planned activities have some potential to present radiological concerns. These concerns have been assessed as being present predominantly in regard to intrusive operations, and when dealing with subsurface media. In fact, a previous effort at NSB-NL involved a surficial radiological investigation, which reportedly did not identify any notable radiological concerns at site surface areas. However, the potential presence of radiological concerns in subsurface media has been indicated in earlier investigatory efforts (refer to Section 4.0 of this HASP).

The presence of radiological materials will be detected through the use of radiation survey instruments. Direct exposure to any gamma radiation will be measured with a portable micro-R (or micro-rem) meter. The presence of other radiological threats in the form of spreadable contamination will be determined using a portable count-rate meter with a Geiger-Mueller (GM) pancake detector. These instruments will be operated at the site locations identified in this HASP as having the potential to involve radiological threats, and at the operational frequencies specified in the Hazard Assessment section (Section 4.0) of this HASP.

The micro-R (or micro-rem) meter will be operated to detect gamma radiation, with measurements made at waist level. Any readings observed that exceed an action level of 0.05 mR/hr (50 microR/hr) will warrant the evacuation of all personnel to an unaffected area. Work will not resume until a qualified health physicist can be consulted for guidance.

The GM detector will be operated as follows:

> The probe is to be moved slowly, at a rate not exceeding two inches per second. The probe must pass within one-quarter of an inch of (but not touching) the surface being screened. If during this monitoring, an action level of 50 counts per minute (cpm) is exceeded, personnel must evacuate the area and undergo decontamination consisting of PPE removal, followed by washing and rinsing exposed skin areas until rescreening with this instrument does not exhibit levels above this action level). Work will not resume until a qualified health physicist is present or consulted for guidance.

The use and application of these action levels shall be based on background readings obtained at the site prior to the commencement of onsite activities. To obtain background readings, the SSO will choose an area of approximately 100 square feet which is suspected to be clean. This area should represent the area to be monitored as closely as possible. Therefore, if monitoring will take place over an asphalt area, so should the attempt at establishing a background. Once an area has been selected based on morphology, topography, and the determination of the existence of contamination, selected points within this area (average 25 feet) will be swept employing the Micro-R to determine the levels of gamma emissions. From these results, the highest and lowest result will be deleted and an average will be taken from the remaining results. This procedure will be repeated using the (GM) Pancake detector, limiting the number of locations within the grid to seven. From this effort, an average background will be obtained from which the aforementioned action levels will be based.

These instruments will be used initially to screen work areas at the beginning of the site's operations. If no levels are detected in these action levels, radiological screening can be discontinued until/unless new operations at that site commence which could be anticipated to expose previously unscreened or unevaluated media (such as at the beginning of an intrusive tasks). Samples collected (i.e., subsurface soils, groundwater, etc.) at the identified sites where this concern exists will be screened as they are collected.

This process will also be performed for investigation-derived wastes, such as drill cuttings an collected purge waters, in order to provide for both worker protection and proper classification for disposal.

5.6 ACTION LEVELS

The following action levels will apply to this project:

5.6.1 LEL/O_2 Monitor

Less than 10% of LEL	Continue work (with proper respiratory protection).
10% to 20% of LEL	Continue work with extreme caution. Eliminate spark-generating activities. Re-evaluate PPE needs.
Greater than 20% of LEL	Withdraw immediately to safe area; notify Base POC, Halliburton NUS Project Manager, and CLEAN HSM.
<19.5% or >25% Oxygen	Cease work and obtain further direction from the CLEAN HSM.
19.5% to 25% Oxygen	Continue work and continue monitoring.

5.6.2 PID Monitoring

Any sustained readings above established background levels in the workers' breathing zones will require immediate retreat to an unaffected area, and the work area will be allowed to ventilate. Work may resume without respiratory protection only when background levels are regained. At site areas where potential inhalation threats consist predominantly in the form of particulates, or gaseous contaminants where air purifying respiratory protection is appropriate (i.e., excluding areas where the substances methylene chloride and vinyl chloride are of concern) work may continue with the use of full-face respirators equipped with combination organic vapor/HEPA filter cartridges up to PID readings of 5 ppm (in worker breathing zones). Above that level, work can continue only in Level B (air supplied respiratory protection). In areas where methylene chloride or vinyl chloride may reasonably be encountered, any sustained breathing zone readings will warrant the immediate evacuation of the area, with work resuming only when background levels are regained or in Level B protection. The use of air purifying respirators is inappropriate unless the presence of these substances can be positively ruled out (i.e., through the use of colorimetric tube analysis).

5.7 INSTRUMENT MAINTENANCE AND CALIBRATION

Air monitoring instruments will be maintained and pre-field calibrated by the equipment supplier. Field calibration will be performed on the PID and the LEL/O_2 meters daily prior to the initiation of work. An additional calibration will be performed at the end of the day to determine any significant instrument drift. The radiation survey meters are calibrated at the factory and will require recalibration every 12 months as per the manufacturer's agreement. The Draeger pump is calibrated quarterly to ensure the flow rate also as per the manufacturer's agreement. Field maintenance will consist of daily cleaning of the instruments using a damp towel or rag to wipe off the instrument's outer casing and overnight battery recharging.

Applicable Halliburton NUS instrument Standard Operating Procedures (SOPs) for this project will be maintained on site. These SOPs include the following:

- No. ME-01, HNU Model P101 Photoionization Detector
- Nos. ME-04 and ME-05, Oxygen Meter and Combustible Gas Indicator, respectively
- ME-09, Radiation Survey Meters

All calibration efforts will be recorded using the forms provided as Table 5-2, "Documentation of Field Calibration." Other recording means (such as field log book entries) will be considered as an acceptable alternative, provided that all of the specified information is recorded.

5.8 RECORDKEEPING

In addition to calibration recordkeeping requirements, all monitoring instrument readings are to be recorded using the form provided as Table 5-3, entitled "Direct Reading-Instrument Response Data." Other recording means (such as field log book entries) will be considered as an acceptable alternative, provided that all of the specified information is recorded.

TABLE 5-2

DOCUMENTATION OF FIELD CALIBRATION

Site Name: Naval Submarine Base - New London

Project No. 9594

Date of Calibration	Instrument Name and Model	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks/ Comments
				Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		

TABLE 5-3

DIRECT READING INSTRUMENT RESPONSE DATA

Site Name: Naval Submarine Base - New London

Project No. 9594

Date and Time	Instrument Operator Name	Instrument Used	Instrument Reading and Duration	Location (e.g., Borehole vs. Breathing Zone)	Operation(s) Being Performed	Personnel in Vicinity at Time of Readings and Level of PPE Worn

6.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

This section presents requirements for the use of personal protective equipment for each of the activities being conducted as defined in Section 3.0 of this HASP. This section includes anticipated levels of protection for each of the activities, the criteria used for selecting various levels of protection, and criteria for modifying levels of protection based on monitoring instrument readings and personal observations.

6.1 ANTICIPATED LEVELS OF PROTECTION

It is planned that all work will be initiated in Level D protection, as defined in Appendix B of OSHA Standard 29 CFR 1910.120 - "Hazardous Waste Operations and Emergency Response." Modifications of this Level D protection may be implemented based on task-specific requirements. Where tasks overlap, the more protective requirements will be applied. Additionally, it is possible that work will be upgraded to Level C protection (air-purifying respirators equipped with HEPA filters), and may involve the need for air supplied respiratory protection depending on the results of air monitoring, as discussed in Section 5.0 of this HASP. However, instances warranting an upgrade of the level of protection for Halliburton NUS and subcontractor personnel as specified in this HASP will require that the Halliburton NUS Project Manager and the CLEAN HSM be notified.

6.1.1 PPE Requirements By Level and Task

Personal Protective Equipment contents and requirements for each of the site tasks are summarized in Tables 6-1 and 6-2.

6.2 PPE SELECTION CRITERIA

Respiratory protection was not selected for use during initial stages of work as it is unlikely that exposures will exceed current permissible exposure limit or threshold limit values. Nitrile and/or neoprene gloves and protective coveralls were selected for certain tasks to provide protection against potential dermal contact with site contaminants. Hard hats, safety glasses, and work boots were selected to provide protection against some of the physical hazards associated with excavating operations and disposable boot covers were selected to help minimize the spread of contamination. Moisture resistant coveralls (Saranex) will be

TABLE 6-1

ITEMS OF PPE BY LEVEL OF PROTECTION
NSB-NLON
GROTON, CONNECTICUT

Safety Equipment	Level B	Level C	Level D
Full-face respirators with combination organic vapor/HEPA filters.		•	
Tyvek splash-resistant suit		•	
Hard hats with splash shields or safety glasses*		•	•*
Steel-toe boots with overboots		•	•
Chemical-resistant outer gloves*	•	•	•*
Tyvek suit or work overalls*			•*
Disposable, latex, inner gloves*	•	•	•*
Pressure-demand, full-face SCBA or pressure-demand supplied-air respirator with escape SCBA	•		
Chemical-resistant clothing (i.e., Saranex coveralls)	•		
Hearing Protection*	•	•	•*
Chemical-resistant safety boots or shoes	•		
Two-way radio	•		
Hard hat*	•	•	•*

* Optional items, at the discretion of the SSO based on current conditions, task-specific requirements, and monitoring instrument results.

Note: Certain activities (i.e., nonintrusive) planned at certain site areas will require only the use of standard field dress. These activities and areas are specified in Section 4.0 "Hazard Assessment" of this HASP. Standard field dress shall include steel-toe/shank work boot or shoe, long pants, and long-sleeved shirt.

TABLE 6-2

PPE REQUIREMENTS BY TASK
NSB-NLON
GROTON, CONNECTICUT

Activity	Level of Protection	Backup Protection
Land Surveys and Geological Surveys	D	--
Soil Gas Surveys	D	C/B
Field Screening	D	--
Soils Testing	D	--
Waste Classification and Disposal	D	C/B
Air Sampling	D	C/B
Monitoring Well - installation, development, sampling	D	C/B
Test Borings and Soil Sampling	D	C/B
Sediment Sampling	D	C/B
Surface Water Sampling	D	C/B
Ecological Sampling	D	C/B
Hydraulic Conductivity Testing	D	C/B

used in place of Tyvek coveralls for tasks or operations that present potentials to result in the saturation of work clothes. Otherwise, when coveralls are necessary to protect workers from dermal exposures and to prevent contamination of street clothing, Tyvek coveralls will be acceptable.

6.3 PPE MODIFICATION CRITERIA

This section presents criteria for upgrading and downgrading chemical protective clothing and/or respiratory protection. Where uncertainties arise, the more protective requirement will apply.

6.3.1 CPC Modification Criteria

Tyvek coveralls and boot covers must be worn anytime there is a reasonable potential for dermal contact with site contaminants or for the contamination of street clothes. Saranex coveralls must be worn anytime there is a reasonable potential for saturation of work clothes.

Nitrile or neoprene gloves must be worn anytime there is a reasonable potential for contact with site contaminants. Samples found to have a pH greater than 2 and less than 12 can be handled with surgical latex gloves.

6.3.2 Respiratory Protection Modification Criteria

Full-face air-purifying respirators equipped with combination organic vapor/high-efficiency particulate air (HEPA) filters must be worn anytime dusty conditions are observed and these emissions cannot be suppressed with water spray. In addition, respiratory protection will be utilized any time action levels specified in Section 5.0 are exceeded. Detection of site contaminants (i.e., methylene chloride, vinyl chloride) where APRs are not suitable for use will require cessation of activities and evacuation of the work site and notification of the PM and the CLEAN HSM. Upgrades to Level B operations will require manning and support from the Health Sciences Department of Halliburton NUS.

6.4 PPE MAINTENANCE AND STORAGE

Unused clothing shall be stored in the project vehicle in empty/clean coolers or in their original cartons. Respiratory equipment shall be thoroughly cleaned by their users after each use and stored in its original container in the project vehicle. Respirator face pieces must never be placed on the ground and must always be protected from physical damage.

6.5 TRAINING, INSPECTION, AND FITTING OF PPE

Site-specific training shall include sufficient instruction on the proper use, limitations (user and equipment), and inspection techniques of PPE. The SSO or their representative will initiate inspection of all protective equipment prior to the commencement of onsite activities and then periodically thereafter until the job is completed. Information concerning these inspections will be recorded in the health and safety logbook. Personnel shall be instructed as to the importance of wearing the proper size of protective clothing. Various sizes of protective clothing shall be present on site and available for use. Those persons who have not been respirator fit-tested within the past year shall be fit-tested by the SSO prior to wearing respiratory protection and at the commencement of onsite activities.

6.6 PPE WORK MISSION DURATION

The majority of items of PPE will involve single-use only procedures. That is, the items will be discarded after each use. Therefore, potentials for exceeding appropriate work mission durations for these items is unlikely. Breakthrough times of the potential site contaminants and the proposed PPE do not require a restriction to site activities based on time. The manner in which this job will be performed proposes a no contact approach when possible, limiting the impact of the work mission duration. Exceptions to this procedure include reusable items such as hard hats, safety footwear, and prescription eye wear. These items will undergo appropriate decontamination between/after use.

7.0 STANDARD WORK PRACTICES

The following standard work practices will apply to all Halliburton NUS personnel as applicable to the work being performed at this site.

7.1 GENERAL REQUIREMENTS (ALL TASKS)

- The Buddy System shall be observed at all times.

- Objects or debris that cannot be manually handled comfortably shall either be handled by more than one person or with mechanical lifting devices. Proper manual material handling techniques are to be followed during any lifting and carrying tasks.

- Eating, drinking, chewing gum or tobacco, taking medication, and smoking or the use of tobacco products are prohibited in the exclusion or decontamination zones, or any location where there is a possibility for contact with site contaminants exists.

- Upon leaving the exclusion zone, hands and face must be thoroughly washed with soap and potable water. Any protective outer clothing is to be decontaminated and removed as specified in this HASP, and left at a designated area prior to entering the clean area.

- Contact with potentially-contaminated substances must be avoided. Contact with the ground or with contaminated equipment must also be avoided. Monitoring equipment must not be placed on potentially contaminated surfaces.

- No facial hair, which interferes with a satisfactory fit of the mask-to-face seal, is permitted on personnel required to wear respiratory protective equipment.

- All personnel must procure a site-specific Health and Safety Plan from the project Site Safety Officer prior to commencing work on site. All site personnel must read and have a working knowledge of this HASP.

- All site personnel must satisfy the training requirements as specified in this HASP (40-hour, supervisory (as appropriate), annual refresher (as appropriate), and emergency response prior to performing any onsite activities.

- All personnel must satisfy medical surveillance requirements and complete a Medical Data Sheet, as presented in this HASP. A copy of that documentation will be maintained on site.

- Any new analytical data must be promptly conveyed via telephone to the CLEAN Health and Safety Manager.

- All work areas must be kept free of ground clutter.

- Areas must be designated for chemical storage. Acids, bases and flammable materials shall all be stored separately. Storage areas must be labeled as to the contents within the storage area.

- All compressed gas cylinders must be stored and used in an upright position, properly secured and protected from damage, segregated, and labelled as empty or full. Any such cylinders involved in welding operations (i.e. oxygen/acetylene welding) will be used, labelled, and maintained in accordance with applicable OSHA regulations.

- Site personnel must immediately notify Halliburton NUS Health Sciences of all incidents for OSHA recordkeeping purposes. All incidents involving worker injury or illness, and near-miss incidents shall be investigated, documented, and applicable corrective measures will be taken to prevent recurrence.

- If personnel note any warning properties of chemicals (irritation, odors, symptoms, etc.) or even remotely suspect the occurrence of exposure, they must immediately evacuate to an unaffected area and notify the CLEAN Health and Safety Manager for further direction.

- Site personnel are not to undertake any activity which would be considered a confined-space entry under any circumstances.

- All cutting and welding operations will be performed in a manner that conforms to both NSB-NLON site and OSHA regulatory requirements.

- Directions to medical support facilities will be posted in all transport vehicles.

- A full-sized copy of the OSHA poster (included in this HASP) shall be conspicuously posted onsite.

- Material Safety Data Sheets for all chemical substances brought onsite will be collected and maintained at the site Command Post (e.g. the site trailer). These documents will be reviewed with the users of the substances prior to any usage or handling.

- All emergency numbers will be posted by identified telecommunications services, and these will be identified and communicated to all personnel prior to commencing work in a new area.

Drilling Operations

- All drilling locations in areas where buried cylinders may have been previously disposed (i.e. Goss Cove and Area A landfills) must be cleared via magnetometer screening prior to initiation of drilling operations.

- No drilling or any other operation which would bring a drill mast or other projection within a 20-foot radius of overhead power lines will be permitted.

- Hand signals with the driller will be established and utilized (if necessary due to conditions such as high ambient noise levels) prior to the commencement of drilling activities.

- All drill rigs and other machinery with exposed moving parts must be equipped with an operational emergency stop device. All personnel working in close proximity must be aware of the location and proper operation of this device. Emergency stop devices will be tested initially and periodically to ensure proper operation. The driller and the helper shall not simultaneously handle moving augers or flytes unless there is a standby person present and available to activate the emergency stop device.

- The driller must never leave the controls while tools are rotating.

- A long-handled shovel or the equivalent shall be used to clear away drill cuttings from the hole and rotating equipment. Hands or feet **shall not** be used for this purpose.

- A remote sampling device must be used to sample drill cuttings near rotating tools. The driller shall shut down operations if the sampler must go near the tools to obtain a sample.

- All personnel working in the vicinity of the drill rig while it is operation shall secure all loose clothing.

- Only manufacturer supplied or approved equipment may be used in conjunction with site equipment (i.e., pins for auger flytes). Projecting pins or other items shall not be permitted on rotating equipment.

- No person shall climb a drill mast while the rig is in operation.

- No person shall climb a drill mast without the use of ANSI-approved fall protection equipment (i.e., belts, lanyards, and a fall protection slide rail) or portable ladders which meet OSHA specifications.

8.0 DECONTAMINATION

This section describes the steps site personnel will follow to prevent the spread of site contaminants into areas that may affect unprotected, unsuspecting site personnel or the public. It includes requirements for decontamination of personnel and sampling equipment. However, as the primary purpose of this HASP is to provide for the protection of site personnel involved in the planned activities, heavy equipment decontamination is not addressed in this section.

8.1 PERSONNEL DECONTAMINATION

The decontamination of personnel and their protective clothing will be performed in three stages.

- Stage 1 includes removing contamination from reusable protective clothing and/or clothing that will be disposed of at sanitary landfills. These efforts will involve washing and rinsing these items in a sequence that begins at the highest level to the lowest level (i.e., from the head down towards the feet).

- Stage 2 will involve removal of protective clothing, discarding disposable clothing into a drum conspicuously marked "Contaminated Clothing" and/or storing reusable protective clothing in the contamination reduction zone. Stage 2 efforts involve a structured, segregated process carefully removing PPE items beginning with the outermost item and progressing inward.

- Stage 3 will consist of workers washing their hands and face with potable water and soap each time they leave the exclusion zone, before performing any type of hand-to-mouth activity. The SSO will identify the nearest wash facility prior to the startup of operations.

All decontamination fluids and solid waste generated will be containerized and disposed of as described in the Field Sampling Plan. The decontamination area will be physically identified with rope or flagging and will be equipped for completion of proper decontamination activities. The location of this area will be determined by the SSO based on site conditions, emergency response support, resource resupply, exclusion zone support requirements, and prevailing wind direction.

8.2 SAMPLING EQUIPMENT DECONTAMINATION

Decontamination of sampling tools may involve the use of deionized water, detergents (Alconox), methanol, and/or nitric acid. Requirements for decontaminating sampling equipment are presented in the Field Sampling Plan. Methanol and nitric acid will only be used in well ventilated areas and personnel will avoid breathing vapor and/or mist. Material Safety Data Sheets for the decontamination solutions will be presented during site specific training, maintained on site for reference, and be made available to any site personnel upon request.

8.3 DECONTAMINATION EVALUATION AND MODIFICATION

- Any grossly contaminated reusable items (i.e., boot covers) that are not visibly cleaned via decontamination efforts are to be discarded.

- Discard and replace decontamination wash and rinse solutions when they become visibly discolored or otherwise noticeably affected.

- Screen employees with monitoring instruments before and after decontamination operations periodically. The HNu will be used to detect organics and some inorganics. The Micro-R meter and the (GM) will be used to detect radiation.

8.4 PPE FOR DECONTAMINATION PROCEDURES

All personnel involved in the execution of decontamination procedures of personnel or equipment will employ latex surgeon's inner gloves, nitrile outer gloves, Saranex coveralls, chemical-resistant boot covers, hard hat, safety glasses, and splash shield, as necessary. Respiratory protection will be equivalent to the level employed in the field associated with the items to be decontaminated.

9.0 TRAINING

9.1 INTRODUCTORY AND REFRESHER TRAINING

9.1.1 Requirements for Halliburton NUS Personnel

All Halliburton NUS personnel must complete 40 hours of introductory hazardous waste site training, and a minimum of three days actual field experience, under direct supervision prior to performing work at the Naval Submarine Base - New London. Additionally, Halliburton NUS personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before being cleared for site work.

Documentation of Halliburton NUS introductory and refresher training can be obtained through the CLEAN Health and Safety Manager. Copies of certificates or other official documentation will be used to fulfill this requirement and will be maintained on site.

9.1.2 Requirements for Subcontractor Personnel

Prior to engaging in any site activities, all Halliburton NUS subcontractor personnel must have completed (and provide documented evidence of receiving) introductory hazardous waste site training (or have equivalent work experience) as specified in OSHA standard 1910.120 (e), and must also have received 8-hours of refresher training if it has been 12 months or more since they received their introductory training. Subcontractors shall certify that their employees satisfy this training requirement by either submitting copies of training certificates, or by submitting a letter, on company letterhead stationery and signed by an officer/owner of that company, containing the information specified in the example letter provided as Figure 9-1. This training certification will be maintained on site.

9.2 SITE-SPECIFIC TRAINING

Halliburton NUS will provide site-specific training to all Halliburton NUS employees and subcontractor personnel who will perform work at this project. This training will only be provided once and personnel who do not attend will not be permitted to perform work at the Naval Submarine Base - New London. Subjects that will be addressed during this site-specific training will include the following:

- Names of personnel and alternates responsible for site safety and health
- Safety, health and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- The contents of this Health and Safety Plan
- Review of relevant MSDSs
- Emergency response procedures

Note: All visitors must meet the requirements of this HASP to obtain clearance to the designated exclusion zones. Visitors who do not meet this requirement will not be permitted passage to the exclusion zones. Preview of other site areas associated with this scope of work may be done only on an escorted basis after receiving the site-specific training and with the Base contact approval.

9.2.1 Site-Specific Training Documentation

Halliburton NUS and subcontractor personnel will be required to sign a statement indicating receipt of site-specific training and understanding of site hazards and control measures. Figure 9-2 will be used to document site-specific training.

FIGURE 9-1

OSHA TRAINING CERTIFICATION

The following statements must be typed on company letterhead and signed by an officer of the company:

LOGO
XYZ CORPORATION
555 E. 5th Street
Nowheresville, Kansas 55555

Month, day, year

Mr. Matthew G. Cochran
Project Manager
Halliburton NUS Corporation
661 Andersen Drive; Foster Plaza 7
Pittsburgh, Pennsylvania 15220-2745

Subject: Hazardous Waste Site Training - Naval Submarine Base - New London

Dear Mr. Cochran:

The employees listed below have had introductory hazardous waste site training or equivalent work experience as required by 29 CFR 1910.120(e). In addition, those employees listed below who have received their introductory training more than 12 months ago have also received 8 hours of refresher training in accordance with 29 CFR 1910.120 (e)(8).

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name of Company Officer)

FIGURE 9-2

SITE-SPECIFIC TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potential hazardous nature of working at the Naval Submarine Base - New London site and that I have received site-specific training which included the elements presented below:

- Names of personnel and alternates responsible for site safety and health
- Safety, health and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- The contents of this Health and Safety Plan
- Emergency response procedures
- Review of relevant MSDSs

I further state that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction.

NAME (PRINT CLEARLY)	SIGNATURE	DATE

Training Conducted By: ______________________ Date: __________________

10.0 MEDICAL SURVEILLANCE

10.1 REQUIREMENTS FOR HALLIBURTON NUS PERSONNEL

All Halliburton NUS personnel participating in project field activities will have had a physical examination meeting the requirements of Halliburton NUS' medical surveillance program (and OSHA standards 1910.120-(f) and 1910.134), and will be medically qualified to perform hazardous waste site work using respiratory protection.

Documentation for medical clearances can be obtained from the CLEAN Health and Safety Manager. A copy of this clearance will be maintained onsite.

10.2 REQUIREMENTS FOR SUBCONTRACTORS

Subcontractors are required to obtain a certificate of their ability to perform hazardous waste site work and to wear respiratory protection. The "Subcontractor Medical Approval Form" provided as Figure 10-1 of this HASP can be used to satisfy this requirement, provided that it is properly completed and signed by a licensed physician.

Subcontractors who have a company medical surveillance program meeting the requirements of paragraph (f) of OSHA standard 1910.120 can substitute Figure 10-1 with a letter (on company letterhead stationery and signed by an officer/owner of that company) that contains all of the information in the example medical surveillance letter presented as Figure 10-2. Figures 10-1 and 10-2 can be combined into one letter.

10.3 REQUIREMENTS FOR ALL PERSONNEL

Each field team member (including subcontractors) and all visitors will be required to complete and submit a Medical Data Sheet (Figure 10-3), prior to the commencement or observation of onsite activities as applicable.

FIGURE 10-1

SUBCONTRACTOR MEDICAL APPROVAL FORM

For employees of ____
Company Name

Participant Name: ______________________ Date of Exam: __________

Part A

The above-named individual has:

1. Undergone a physical examination in accordance with OSHA Standard 29 CFR 1910.120, paragraph (f) and found to be medically -

   ( ) qualified to perform work at the **Naval Submarine Base - New London** work site
   ( ) not qualified to perform work at the **Naval Submarine Base - New London** work site

   and,

2. Undergone a physical examination as per OSHA 29 CFR 1910.134(b)(10) and found to be medically -

   ( ) qualified to wear respiratory protection
   ( ) not qualified to wear respiratory protection

My evaluation has been based on the following information, as provided to me by the employer.

( ) A copy of OSHA Standard 29 CFR 1910.120 and appendices.
( ) A description of the employee's duties as they relate to the employee's exposures.
( ) A list of known/suspected contaminants and their concentrations (if known).
( ) A description of any personal protective equipment used or to be used.
( ) Information from previous medical examinations of the employee which is not readily available to the examining physician.

Part B

I, ______________________ have examined ______________________
Physician's Name (print) Participant's Name (print)
and have determined the following information:

1. Results of the medical examination and tests (excluding finding or diagnoses unrelated to occupational exposure):

   ____

   ____

   ____

FIGURE 10-1
SUBCONTRACTOR MEDICAL APPROVAL FORM
PAGE TWO

2. Any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health:

____

____

____

3. Recommended limitations upon the employee's assigned work:

____

____

____

____

I have informed this participant of the results of this medical examination and any medical conditions which require further examination of treatment.

Based on the information provided to me, and in view of the activities and hazard potentials involved at the ______________________ work site, this participant

( ) may
( ) may not

perform his/her assigned task.

Physician's Signature ______________________

Address ______________________

Phone Number ______________________

NOTE: Copies of test results are maintained and available at:

____
Address

FIGURE 10-2

MEDICAL SURVEILLANCE LETTER

The following statements must be typed on company letterhead and signed by an officer of he company:
LOGO
XYZ CORPORATION
555 E. 5th Street
Nowheresville, Kansas 55555

Month, day, year

Mr. Matthew G. Cochran
Project Manager
Halliburton NUS Corp.
661 Andersen Drive
Pittsburgh, Pennsylvania 15220

Subject: Medical Surveillance - NSB-NL

Dear Mr. Cochran:

As an officer of XYZ Corporation, I hereby state that the persons listed below participate in a medical surveillance program meeting the requirements contained in paragraph (f) of Title 29 of the Code of Federal Regulations (CFR), Part 1910.120 entitled "Hazardous Waste Operations and Emergency Response: Final Rule." I further state that the persons listed below have had physical examinations under this program within the past 12 months and that they have been cleared, by a licensed physician, to perform hazardous waste site work and to wear positive and negative pressure respiratory protection. I also state that, to my knowledge, no person listed below has any medical restriction that would preclude him/her from working at NSB-NL.

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name of Company Officer)

FIGURE 10-3

MEDICAL DATA SHEET

This form must be completed by all on-site HNUS personnel and subcontractors, prior to the commencement of activities, and shall be kept in the site command post during site activities. This form must be delivered to any attending physician when medical assistance is needed.

Site ____

Name ______________________ Home Telephone (   ) __________

Address ____

Date of most recent physical examination* _____/_____/_____

Age __________ Height __________ Weight __________

Name of next of kin ____________________ Telephone (   ) __________

Drug allergies or other allergies ______________________________

____

Previous Illnesses or Exposures to Hazardous Substances:

____

____

Current Medication (prescription and non-prescription):

____

____

Medical Restrictions ____

____

____

Name, address, and phone number of personal physician ______________________

____

____

*Confirmed by Site Safety Officer (SSO) ______________________ __________

Signature of SSO   Date

11.0 SITE CONTROL

Work zones will be delineated for each of the site areas included in this effort. The SSO is responsible for delineating these zones based on site conditions. Halliburton NUS will designate and utilize these work zones in conjunction with proper decontamination procedures to prevent the spread of contaminants into previously unaffected areas of the site. It is anticipated that a three zone approach will be used during work at this site; exclusion zone, contamination reduction zone, and support zone. Figures for the individual sites are included in the Work Plan and will be maintained onsite. Updates concerning locations of zones, level of protection, and levels of contaminants will be added as this information is developed. These figures may be used by the SSO to aid in determining appropriate work zones at each site.

11.1 EXCLUSION ZONE

The exclusion zone (EZ) will be considered those areas of the site of known or suspected contamination. The EZs for this project will be limited to those areas where active work is being performed and/or anywhere there is believed to be the potential for exposure to site contaminants. Where appropriate, EZs will be designated as the actual work area, minimizing their size. For example, the work area in the immediate vicinity of a drill rig (approximately a 20-foot radius around the rig) will commonly be established as an EZ.

No one may enter or perform work in an established EZ unless they satisfy all medical surveillance, training and site clearance requirements', and they are properly outfitted in the appropriate PPE.

11.2 CONTAMINATION REDUCTION ZONE

A contamination reduction zone (CRZ) will be established as a buffer area between the designated EZs and any areas of the site where contamination is not suspected. CRZ locations will be established at the perimeter of the EZ locations. The heavy equipment decontamination area established for this project will be designated and established as a separate CRZ.

11.3 SUPPORT ZONE

The support zone for this project will be established at areas of the site where exposure to site contaminants would not be expected during normal working conditions or foreseeable emergencies.

The support zone will be the area where the site command post (i.e., site trailer) is positioned, and where supplies and equipment are maintained.

11.4 SITE SECURITY

Base security will provide the initial line of security based on access to the facility. A secondary line of security to the work zones (more pointedly the Exclusion Zone) will be conducted by the FOL or SSO while engaged in site activities. All zones will be baricaded using barricade tape or construction fencing and will be identified as an exclusion zone and the hazards associated with entering to inform people who may attempt to enter after hours.

11.5 SITE COMMUNICATIONS

Onsite communication will be conducted using two way radios and cellular telephones. The cellular telephones will also be employed, in the unlikely event, to contact emergency services.

12.0 OTHER MISCELLANEOUS REQUIREMENTS

12.1 CONFINED SPACE ENTRY

No personnel, under any circumstances, are to enter confined spaces. Therefore, it is not applicable to specify procedures for such operations in this Health and Safety Plan.

12.2 SPILL CONTAINMENT PROGRAM

It is not anticipated that bulk hazardous materials will be handled as part of this scope of work such that spillage would constitute a danger to human health or the environment. Therefore, a spill containment program has not been developed as part of this HASP.

12.3 MATERIALS AND DOCUMENTS

The Halliburton NUS Field Team Leader shall ensure the following materials/documents are taken to the project site and utilized as required.

- Incident Report Forms
- Medical Data Sheets
- Material Safety Data Sheets for decon solutions and other substances brought to the site
- Site-Safety Follow-Up Reports (to be completed by the Field Team Leader)
- OSHA Job Safety and Health Poster (posted in site trailer)
- Training Documentation Form (Blank)
- First Aid Supply Usage Form
- Emergency Reference Form (Figure 13-1, extra copy for posting)
- User manuals for HNU, LEL/O_2, and Radiation Survey Meters

13.0 EMERGENCY RESPONSE PLAN

13.1 INTRODUCTION

This Emergency Response Plan (ERP) has been developed to address emergency situations that could arise as a result of activities associated with this investigatory effort at Naval Submarine Base - New London. This ERP has been prepared in accordance with the requirements of OSHA standard 29 CFR 1910.38(a), as provided for in standard 1910.120(l)(ii). In this manner, in the event of any emergency situation (i.e., fire, contaminant release, etc.), Halliburton NUS and subcontractor personnel will evacuate the work area and notify Base support (and/or offsite services, if necessary). Halliburton NUS and subcontractor personnel are not authorized to participate in either defensive or offensive emergency response or emergency rescue operations (with the only exception being as specified in Section 13.5).

This ERP shall be reviewed with all involved Halliburton NUS and subcontractor personnel as part of their initial site-specific health and safety training.

13.2 PRE-EMERGENCY PLANNING

Pre-emergency planning activities associated with this project include the following:

- Coordinating with Naval Submarine Base - New London personnel to ensure that Halliburton NUS emergency response activities are compatible with existing facility emergency response procedures. This will include providing a copy of this ERP to the identified Base POC and the identified Emergency Services for review and comment.

- Establishing and maintaining information at the project support zone for easy access in the event of an emergency. This information will include the following:

    - An inventory of chemical substances used on site, with corresponding Material Safety Data Sheets.

    - Site personnel records regarding medical treatment concerns (medical data sheets).

    - A log book identifying personnel present on site each day.

- Identifying a chain of command for emergency response. In this regard, Naval Submarine Base - New London will assume control of any situation to which they respond.

13.3 ERP ELEMENTS

This section presents the basic elements of this ERP, to provide for the protection of personnel health and safety in the event of an emergency situation, and to comply with applicable OSHA requirements addressing emergency planning.

13.3.1 Emergency Escape Procedures and Escape Route Assignments

As the planned effort involves multiple site areas, specific information in regard to emergency escape will be addressed from a site-specific standpoint. This will involve the efforts of the FOL and the SSO in establishing these items as part of site mobilization efforts, prior to the initiation of any activities at a site. This shall include inspecting the site area and identifying primary and alternate escape routes, and safe places of refuge. These determinations will be communicated to all worker who will be involved in that site's activities as part of their site-specific training and as preliminary briefings prior to the commencement of onsite activities in that particular area.

13.3.2 Critical Operations Concerns

No critical operations are recognized where an individual would have to remain on site in the event of an emergency situation. As a result, all personnel are to evacuate the site area when so directed. Operators of equipment will deactivate or disengage equipment prior to evacuating, provided that this requires minimal time and effort and does not place the operator in any danger, and does not significantly delay their evacuation. An example of such an effort may include the activation of the drill rig emergency stop device.

13.3.3 Employee Accounting

If an evacuation is performed, all personnel shall immediately report to the specified site refuge location. At that location, the FOL, with assistance from the SSO, as necessary will be responsible for providing for employee accounting. This will be accomplished via taking a roll call using the daily entry in the field log book. If any individuals cannot be accounted for, attempts will be made to gather the following information which shall be provided to emergency response personnel upon their arrival:

- Name and brief description of missing individual(s), including type/color of clothing worn
- Location where individual may be located (last seen)
- The Medical Data Sheet for the individual
- Any other information that may be relevant or useful to rescue personnel

13.3.4 Rescue and Medical Duties

As previously specified, Halliburton NUS and subcontractor personnel are not authorized to participate in emergency rescue and medical duties.

13.3.5 Emergency Reporting Procedures

In the event of an emergency situation, the Halliburton NUS FOL, with assistance from the contractor supervisor, as necessary will be responsible for determining the need for, and carrying out communications with the NSB-NLON Fire Department. All emergency situations are to be communicated (via the nearest available telephone) directly to the NSB-NLON Fire Department. Personnel at that location are authorized to deploy emergency resources as needed. Figure 13-1 provides telephone numbers that may be necessary in the event of an emergency.

13.3.6 ERP Informational Contacts

If additional information on the contents or intentions of this ERP are desired, the Navy CLEAN Health and Safety Manager should be contacted. This individual is Mr. Matthew M. Soltis, CSP, and can be reached at (412) 921-8912.

If additional information regarding the NSB - NLON site is needed, or information regarding Base services and capabilities is desired, the Base POC (Mr. Dick Conant) can be contacted at the Public Works Office in Building 135, at (203) 449-3644.

FIGURE 13-1

EMERGENCY REFERENCE
NSB-NLON
GROTON, CONNECTICUT

ONSITE EMERGENCY CONTACTS AT NSB-NLON

Emergency (Including Ambulance and Fire)	(203) 449-3333
Security Dispatch	(203) 449-3222
Naval Hospital General	(203) 449-4877
Naval Hospital Emergency Room	(203) 449-3666
Trouble Desk (Utility Emergencies) Jennifer Lewis or Veronica Labasi	(203) 449-4711
Naval On-Scene Coordinator (Site Contact) Dick Conant	(203) 449-3644

OFFSITE EMERGENCY CONTACTS

Lawrence and Memorial Hospital (New London), General Number	(203) 442-0711
Police (Town of Groton)	9-1-1 or (203) 445-2451
Fire/Ambulance (Town of Groton)	9-1-1 or (203) 445-2456
Police (Ledyard - north part of Base)	9-1-1 or (203) 464-8225
Fire/Ambulance (Ledyard - north part of Base)	9-1-1 or (203) 464-9222

ADDITIONAL CONTACTS

National Information Centers: Chemtrec	(800) 424-9300
National Response Center	(800) 424-8802
Agency for Toxic Substances and Disease Registry	(404) 639-0700
Halliburton NUS Project Manager: Matthew Cochran	(412) 921-8418
Halliburton NUS Navy CLEAN Health & Safety Manager: Matthew Soltis	(412) 921-8912
Halliburton NUS Medical Consultant: Pittsburgh Office Dr. Teresa Silvaggio	(412) 777-6369

13.4 ALARM SYSTEM

Since Halliburton NUS personnel will be working in close proximity to each other, and since the size of the field team is anticipated to be less than 10 people at any specific work site, hand signals and voice commands will be sufficient to alert site personnel of an emergency. This approach is in accordance with OSHA standard 1910.38(a)(3)(i) and 1910.165(b)(5). If ambient noise levels are at a level where voice communication may be ineffective, hand-held air horns will be used as an audible alarm. For each of the sites involved in this effort, the SSO (with assistance from the FOL) will identify the nearest available telephone, in addition to the cellular telephone maintained onsite, which will be used for emergency reporting. This will be done as part of the mobilization effort for each site, prior to the initiation of any site operations.

13.5 EVACUATION

In the event that an evacuation becomes necessary as a result of an emergency situation, a total site evacuation will be executed. All personnel working in that area will report to the designated refuge location and remain there and await further instructions from the FOL or the SSO.

In the event of an evacuation, the procedure for response will be as follows:

- Step 1 - The victim(s) will remove themselves (if possible) from the hazard or a co-worker may attempt to rescue the victim(s) if rescue can be accomplished simply, timely, and without endangering life or health. Before a rescue is attempted, the rescuer must identify the cause of the injury or illness and ascertain that a rescue can be performed safely. If uncertainty exists, rescue at this time will not be initiated.

- Step 2 - The victim(s) or witnesses will notify the Halliburton NUS FOL of the nature of the injury/illness, if that individual is not already aware of the situation.

- Step 3 - The Halliburton NUS FOL will notify the SSO, and then notify the NSB-NLON Fire Department (via the nearest available telephone) if the injury/illness will require medical attention.

- Step 4 - The NSB-NLON Fire Department will deploy a Medical Team as needed and will notify the medical facility to prepare for the arrival of the injured/ill party.

- Step 5 - The SSO will: (1) deploy to the scene appropriately equipped with first-aid supplies; (2) don any protective equipment needed to treat the injured; (3) provide first-aid services within their capabilities and training; (4) Determine, coordinate, and perform any necessary emergency decontamination based on the injuries involved and other current conditions, and; (5) transport the victim to the support zone and/or to the medical facility (as appropriate) if transport can be accomplished without aggravating the injury.

- Step 6 - The Halliburton NUS FOL will ensure that all persons with chemically related injuries/illness are examined, by a licensed physician who is in contact with the Halliburton NUS Health Sciences Manager and the Medical Consultant, at the earliest possible time following the incident.

- Step 7 - The Halliburton NUS FOL and SSO will: (1) perform a critique of the incident, as specified in 13.7, below; (2) determine measures to prevent recurrence; (3) determine measures to improve response efforts; (4) complete an incident report, as appropriate.

13.6 TRAINING

As specified previously, the contents of this ERP will be reviewed with each site individual as part of the initial health and safety training. This training shall also include the site-specific information specified in this ERP that is to be obtained as part of site mobilization efforts (i.e. specific evacuation routes and safe places of refuge, nearest telephone, etc.).

Additional emergency response training is not necessary as site personnel are not authorized to participate in emergency response operation. Halliburton NUS personnel will rely on Navy base support for first aid and CPR functions.

13.7 EMERGENCY CRITIQUE AND FOLLOW-UP

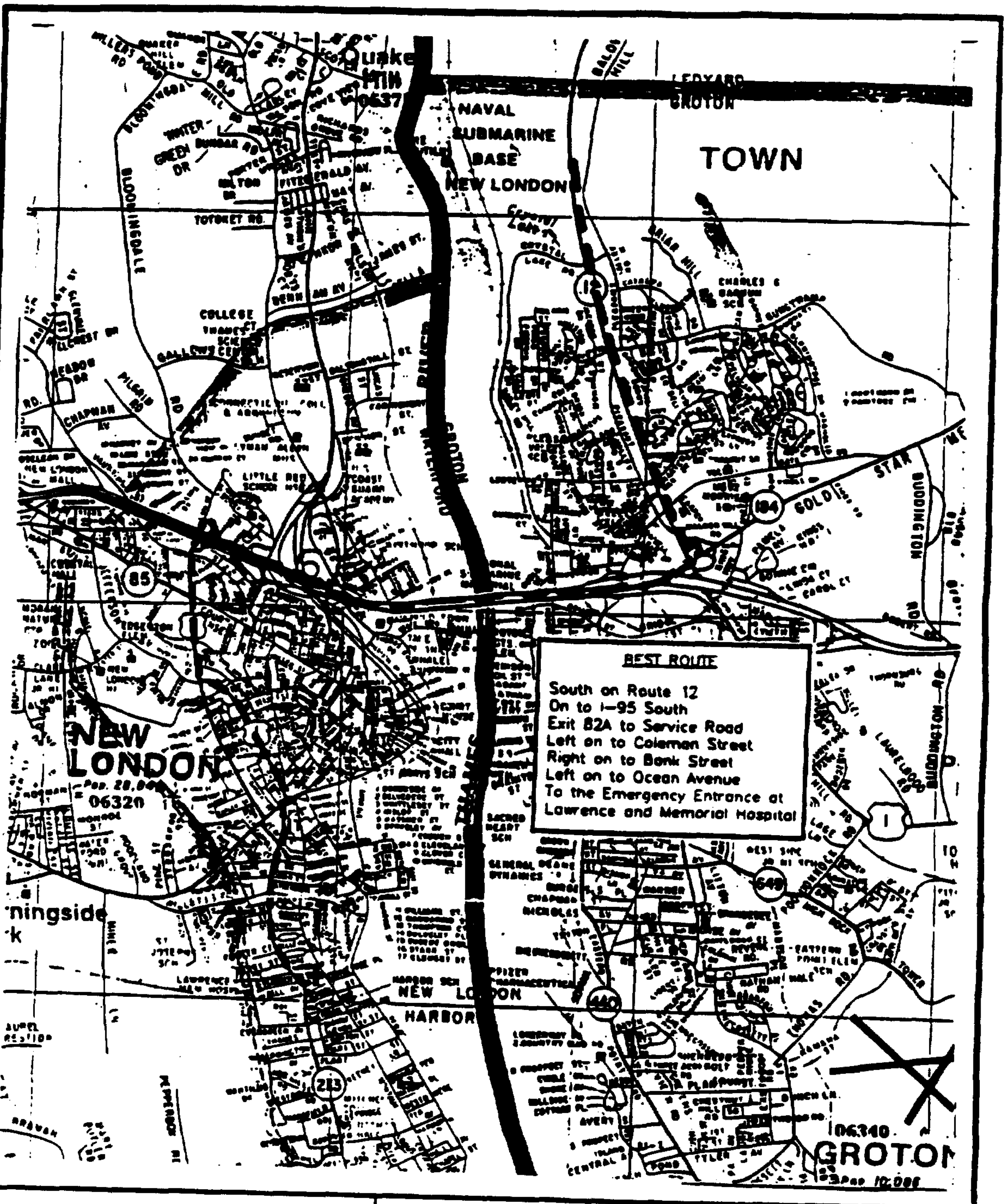
Any emergencies that occur during the performance of site activities will be critiqued by the Halliburton NUS FOL and the SSO. The objective of these critiques will be to identify any areas for improvement. Any weaknesses that are identified will be followed up by the Halliburton NUS FOL, the SSO and the Navy CLEAN HSM to ensure that necessary modifications are made to this ERP; the site-specific health and safety plan; and any other applicable procedures.

13.8 EMERGENCY CONTACTS

The primary contact in an emergency situation is the NSB-NLON Fire Department. This department is manned on a 24-hour basis, and is charged with response activities including making the critical decisions regarding where an injured person is to be transported. Responders from this department have been trained in hazardous waste emergency response. In case of immediate threat of life, the Naval Hospital on NSB-NLON will be used; otherwise persons will be transported to Lawrence and Memorial Hospital in New London. Previous clearance will be obtained to transport potentially contaminated individuals to these facilities for medical treatment. Anyone transported to a medical treatment facility will have their medical data sheet and a copy of this HASP for physician referral.

13.9 EMERGENCY ROUTE TO HOSPITAL

The most direct route to the Lawrence and Memorial Hospital is to travel South on Route 12 and exit onto I-95 South. Take Exit 82A to the Service Road and continue until turning left on Coleman Street. Travel on Coleman to the intersection with Bank Street and turn right. Continue on Bank to the intersection with Ocean Avenue and turn left. Continue towards and follow the signs for the Emergency Entrance. The attached map (Figure 13-2) is included to illustrate this route. Two members of the field team are required to drive the route to the hospital prior to the start of work.



INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CT

N

FIGURE 13-2
ROUTE TO
LAWRENCE AND MEMORIAL
HOSPITAL

APPENDIX I

SITE DESCRIPTIONS

APPENDIX I

SITE DESCRIPTIONS

The site descriptions presented in this appendix have been excerpted from Section 8.0 of the Phase I Remedial Investigation report for Naval Submarine Base - New London, prepared by Atlantic Environmental Services, Inc. (Atlantic), in August of 1992. In addition to excerpts, general site descriptions for the Weapons Center and the Thames River site areas have been included, as planned site activities are also to involve those two locations. Those two descriptions have been excerpted from the Phase II Remedial Investigation Work Plan document, which was also prepared by Atlantic, dated May of 1993.

8.0 SUMMARY AND RECOMMENDATIONS

This section discusses the summary and conclusions of the investigations and evaluations at each site. Included are overviews of site background, nature and extent of contamination, and health and ecological risk assessment. Based on this information, for Step I sites, a recommendation is provided for proceeding to Step II, or for no further action. A no further action recommendation is based on identification of no significant contamination, exceedances of ARARs, and no health and ecological risk. Recommendations to proceed from Step I to Step II are based on identification of contaminants above applicable ARAR/TBC values, and where health and ecological risks are of concern. **ARAR/TBC values are detailed in Section 4.0.** In some cases, recommendations to proceed from Step I to II are based on the need for further delineation of the extent of contamination (e.g., Battery Acid Disposal Area), or to define the source of contaminants (e.g., Torpedo Shops).

Risk estimates for human health effects associated with exposure to potential carcinogens are expressed as the lifetime probability of excess cancer associated with the given exposure (e.g., a lifetime incremental risk of one in ten thousand). Risks above 1.0E-4 are described here as "generally unacceptable for environmental risks to humans, and risks below 1.0E-6 are described here as generally considered *de minimus* for environmental risk to humans. Risk estimates for human health effects associated with exposure to non-carcinogens are evaluated by using the total hazard index ratio. The total hazard index ratio is estimated by summarizing the hazard index ratios for each compound. The hazard index ratio for a compound is the ratio of its exposure dose to its reference dose. Ratios in excess of "1" are viewed here as benchmarks with regard to the potential for chronic, generally sublethal, effects. Risk characterization for the ecological risk assessment relies upon the toxicity quotient approach as well as on direct observations of conditions in the field. These approaches provide an overall "weight of evidence" approach for the assessment. The toxicity quotient is the ratio of a compound's exposure dose to its effects level, normally its NOAEL. Values above 1 indicate some potential for environmental effects. Values above 10 indicate good potential that greater exposure could result in effects based on experimental evidence, and values above 100 indicate effects may be expected based on the fact that this represents an exposure level at which effects have been observed in other species. In some cases, assessments regarding environmental risk were made by directly comparing exposure point concentrations to known toxicity data or developed criteria.

Step II sites will now proceed to the Feasibility Study (FS). The Feasibility Study is a detailed evaluation of remedial (clean-up) alternatives at each Step II site, including no action.

The following discussion of summary and recommendations is provided for each site.

8.1 Step I Sites

8.1.1 CBU Drum Storage Area

8.1.1.1 Summary

Background: The CBU Drum Storage Area is located in the northern section of NSB-NLON, adjacent to the deployed parking lot, and within the Area A Landfill. Twenty-six 55 gallon drums of waste oil, lube oil, and paint materials were previously located at this site.

Nature and Extent of Contamination: Seven (7) surface soil samples were collected from three sample locations to screen for potential contamination. Low concentrations of VOCs and SVOs were detected in the surface soils at this site. However, concentrations were below TBC values. Lead exceeded the TBC values for TCLP analysis, and was also slightly above the established background concentration at two sample locations. The pesticide DDD was also detected at a low concentration, consistent with the past application of pesticides within Area A. The chemicals detected at this site are generally consistent with the past storage of oil and indicate that a small release may have occurred.

Health and Ecological Risk Assessment: The low concentrations of chemicals detected at this site do not cause a risk with respect to health or ecological impact.

8.1.1.2 Recommendations

Supplemental Step I investigations are recommended to determine if Step II investigations are necessary or to support a no further action recommendation.

8.1.2 Rubble Fill at Bunker A-86

8.1.2.1 Summary

Background: Bunker A-86 is located on a dirt road off of Wahoo Avenue in the north central section of NSB-NLON. Area A Landfill is adjacent to the north, and the NSB-NLON hazardous waste storage facility is adjacent to the south. The rubble fill area is located to the north of the dirt access road and to the west of the bunker.

Discarded construction material is present at this site including concrete, asphalt, an electric motor, wood and gravel. Chemical containers found at this site included an empty 5-gallon container of monothanolanine (labelled as corrosive product), an empty 5-gallon container of thorite (labelled as non-shrinking compound for patching concrete), and a 55-gallon drum of lube oil that was approximately ten percent full.

Nature and Extent of Contamination: Five (5) surface soil samples were collected for analysis from this site from two sample locations to screen for contamination. Solvents (trichloroethene, tetrachlorethane) were detected in the 1-2 ppb range, below TBC values. One sample was analyzed for SVOs and contained elevated concentrations of PAHs, possibly indicative of an oil release or combustion by-products. Low concentrations of pesticides (delta-

BHC, methoxychlor) were detected which are likely associated with past Area A applications. Arsenic was present at a concentration well above background levels at the one sample analyzed on a mass weight basis. The concentration of arsenic (127 ppm) was one of the highest detected compared with all other sites investigated.

Health and Ecological Risk Assessment: Activity in this area is negligible. However, based on the elevated levels of PAHs and arsenic, there could be potential health risks if exposures were to occur under some future use condition.

8.1.2.2 Recommendations

It is recommended that this site proceed to the Step II phase of the IR program. Additional soil sampling and potential ground water monitoring is recommended at this site to further characterize the nature and extent of contamination and to conduct a quantitative health and environmental risk assessment.

In the interim, it is recommended that the containers at this site be removed and properly disposed.

8.1.3 Torpedo Shops

8.1.3.1 Summary

Background: The Torpedo Shops are located in the northern portion of NSB-NLON on the north side of Triton Avenue. The two buildings onsite (Nos. 325 and 450) are torpedo overhaul/assembly facilities. These facilities were connected to an onsite septic system leachfield until 1983, when they were connected to municipal sewers. A variety of fuels, solvents and petroleum products are used in these buildings. Direct disposal of these wastes to the septic system was reported not to be a routine practice, although sporadic, inadvertent chemical discharges to the subsurface septic system is of concern.

Nature and Extent of Contamination: Nine surface soil samples and three ground water samples were collected and analyzed to screen for potential contamination at the former subsurface septic systems.Low concentrations of VOCs and SVOs were detected in the north and south septic systems. Only one detection of benzene (4 ppb), was slightly above the TBC value of 1 ppb. Antimony exceeded background levels at the majority of sample locations in the south septic system, and silver was present close to or above background levels at the same sample locations. It is possible that the elevated antimony and silver are associated with a by-product of the torpedo overhaul process which occurred in Building 325. PCB was detected at 600 ppb (below TBC values) in a soil sample from the north septic system. DDE was detected at 210 ppb in a soil sample from the south septic system. The source of the PCB and DDE is unknown.

No primary drinking water standards were exceeded in the three ground water samples for VOCs or metals. No SVOs, pesticides/PCBs were detected in the ground water. Several VOCs were detected in the overburden ground water in the south septic system. These included 1,1,1 trichloroethane (42 ppb), 1,1 dichloroethene (30 ppb), and 1,1 dichloroethane (1 ppb), which were present below applicable drinking water standards. Because the soil gas survey and subsurface soil sampling within the septic leaching field did not indicate the presence of significant levels of VOCs, the presence of these solvents in the ground water suggest the potential for an undefined source. It is possible that the source of these solvents is upgradient of this location, in the vicinity of the Torpedo Shop buildings. The former hazardous waste sump, Otto fuel storage tanks, and drum storage are possible sources. Also, due to the density of these solvents, higher concentrations may be present in the bedrock aquifer. Antimony exceeded the USEPA health advisory standard in the ground water (south septic system) by over 20 times. This correlates with the elevated levels of antimony detected in the soils at this site. Because the antimony was present in the upgradient soil sample (7MW1), but not necessarily a background sample, it is unclear if the antimony in the soil/ ground water is related to septic system discharges.

Health and Ecological Risk Assessment: The potential exposure scenario relates to utility repairs/installations within the former septic system area. Based on the relatively low levels of chemicals present at the site, and the health risk calculations made for utility workers at other sites (Area A Landfill, Lower Subase), the health risks associated with this exposure scenario are qualitatively predicted to be negligible. Based on the lack of potable water supply wells for existing and projected future land use in the area, there is no exposure, therefore, no human health risks are associated with the chemical constituents in the ground water. The site is developed, therefore there are no significant ecological risks.

8.1.3.2 Recommendations

It is recommended that this site proceed to the Step II phase of the IR program. Further soil and ground water investigation is recommended at this site to define the source, nature and extent of VOC contamination, and to further address the elevated antimony at this site. No further action is required relative to the septic systems, except as they may relate to the antimony issue. The testing will be in the vicinity of the buildings and at the Otto fuel sump.

8.1.4 Goss Cove Landfill

8.1.4.1 Summary

Background: The Goss Cove Landfill site is located in the southwest portion of NSB-NLON, adjacent to the Thames River. The Nautilus Museum and a paved parking lot are constructed directly over the former landfill. The Nautilus Museum is a submarine museum operated by the Navy and open to the public.

The landfill reportedly operated from 1946 until 1957 and filled in the northern portion of Goss Cove. The southern portion of Goss Cove remains. Incinerator ash, inert rubble, and potentially other unknown materials were disposed at the site.

Nature and Extent of Contamination: A radiation, geophysical, and soil gas survey were conducted. No radiation above background was detected. The geophysical survey identified several suspected buried metal objects, which were avoided during drilling operations. The soil gas survey assisted in defining elevated VOCs in several areas.

Seven subsurface soil samples, four ground water and one surface water sample were collected and analyzed to screen for potential contamination.

The subsurface test boring program indicated that landfill material consisted of sand and gravel with small quantities of brick, glass, ash, wood, and metal. Minor oil stains or sheens were observed in approximately one-half of the borings, indicating some petroleum disposal/spills took place.

VOCs were detected in five of seven soil samples. Xylene was the most prevalent constituent, detected in four samples, indicative of a petroleum product. Trichloroethene and tetrachlorethene were detected in one soil sample each. Petroleum hydrocarbons (benzene, toluene), and tetrachlorethene were detected above TBC values in one soil sample each.

SVOs, predominantly PAHs, were detected at all seven subsurface soil samples, several at relatively high levels. The PAHs are likely associated with the disposal of incinerator ash and potentially associated with the presence of petroleum hydrocarbons.

PCBs or pesticides (predominantly DDT, DDD and DDE) were present individually at all sample locations. All concentrations were below TBC values except for DDT at one sample location. The presence of PCBs and pesticides are likely associated with past landfill disposal.

Many inorganic constituents exceeded established background levels, and exceed TBC values based on TCLP analysis. Arsenic, cadmium, chromium, and lead exceed both background levels and TCLP TBC values. Mercury consistently exceeded background levels at most sample locations. Elevated metals are anticipated to be related to past landfilling activities and, potentially, battery related disposal (lead/cadmium).

The highest levels of VOCs in the ground water were detected in the two downgradient wells. Vinyl chloride or benzene were present individually in the ground water at a downgradient well above ARAR values. Petroleum hydrocarbons detected (which were detected in subsurface soils) included benzene, toluene, ethylbenzene, and xylene; trichloroethene and tetrachlorethene were not present in the ground water. Low levels of SVOs are present in the ground water, primarily the more soluble PAHs, including naphthalene. Naphthalene exceeded the TBC values (USEPA Health Advisory) in a downgradient monitoring well.

Barium exceeded the primary MCL at one well; secondary MCLs were exceeded in all wells for sodium, iron, and manganese. The sodium is related to the brackish water conditions.

Gross alpha and/or gross beta radiation screening values were exceeded in two ground water monitoring wells within the landfill. These elevated readings could be the result of naturally occurring radioisotopes, but further analysis is required for confirmation.

The one surface water sample collected in the Thames River adjacent to the site did not contain VOCs, SVOs, pesticides or PCBs. Inorganic constituent values appear consistent with brackish water. **Copper was present above water quality standards.**

In summary, the levels of VOCs and SVOs in the subsurface soils are having some impact on ground water quality (some slightly above ARARs/TBCs), but overall the concentrations are relatively low. The elevated inorganics in soils, principally arsenic, cadmium, chromium, lead and mercury, are not adversely impacting ground water quality.

Health and Ecological Risk Assessment: Future construction and excavation activities in the parking lot could result in some risk to workers, if proper health and safety procedures are not followed. There is some potential that vapors from within the landfill could enter the museum building, however, this possibility has not been fully investigated. There is also a possibility that children could come in contact with sediments in Goss Cove. At present there are no data on the level of contaminants in these sediments.

Although ground water quality exceeded drinking water standards, no drinking water wells are within the affected area, nor could they be due to the proximity to the brackish Thames River.

Ground water from Goss Cove Landfill discharges to the Thames River. Based on the data presented in this report, a qualitative assessment indicates that contaminant concentrations in ground water at these sites are expected to be below water quality criteria after further dilution in ground water, attenuation due to adsorption to soils, and dilution in the Thames River estuary. Risks to aquatic life due to contaminants in ground water discharge from the site are also expected to be low.

8.1.4.2 Recommendations

It is recommended that this site proceed to the Step II phase of the IR program. Specifically, the following recommendations are provided.

1. Specific worker health and safety provisions are recommended for all future subgrade construction projects at the site. Prior to construction in specific areas, further subsurface investigation should be conducted to characterize the quality/ disposal and health and safety requirements of the material to be encountered. **It should be noted that some utility reconstruction is being designed.**

2. The geophysical survey indicated the presence of buried metal objects at three locations as specified in Section 4.0. Any future planned construction near these areas should include exploratory excavation in these areas to identify construction health and safety requirements.

3. It is recommended that several borings/soil analyses be conducted in the area closer to the Nautilus Museum and remaining Goss Cove. This should be performed in conjunction with indoor air quality measurements within the Nautilus Museum building to assess potential health risks.

4. A quantitative health and environmental risk assessment of the potential impact of the site on the Thames River should be conducted to verify the

qualitative assessment that impacts appear negligible. This would include surface water samples at low tide (ground water discharge) conditions, sediment sampling, and biota survey/sampling along the Thames River and Goss Cove shoreline.

5. Conduct another ground water sampling and analysis round for TCL organics and TAL inorganics to confirm the analytical results. Also, perform specific radiological isotope ground water analysis to determine the source of the radiological constituents (natural or otherwise).

8.1.5 OBDANE

8.1.5.1 Summary

Background: The Over Bank Disposal Area Northeast (OBDANE) site is located in a heavily wooded area on the edge of a ravine northwest of Area A Landfill, and south of the Torpedo Shops. Inspections of this site have indicated the presence of several empty fiber drums in this area. No visual staining or stressed vegetation was observed.

Nature and Extent of Contamination: Five (5) surface soil samples were collected for analysis from this site, from two sample locations, to screen for potential releases at this site. One surface soil sample contained tetrachlorethene at 2 ppb, below the TBC value. No SVOs, PCBs, or pesticides were present. No inorganic compounds exceeded established background levels or TBC levels based on TCLP analysis.

Health and Ecological Risk Assessment: This site appears to pose a negligible risk based on the lack of activity and the low concentration of chemicals.

8.1.5.2 Recommendations

Supplemental Step I investigations are recommended to determine if Step II investigations are necessary or to support a no further action recommendation.

8.1.6 Spent Acid Storage and Disposal Area

8.1.6.1 Summary

Background: This site is located in the southeastern section of NSB-NLON, between the southern side of Buildings 409 and 410. A 4' x 4' x 12' long rubber-coated underground tank was used for temporary storage of waste battery acid around World War II. The tank top is still visible, but has been filled with earth and capped with concrete.

Nature and Extent of Contamination: Seven subsurface soil samples were collected to screen for potential release of battery acids from the subsurface tank. High levels of lead were present in six of seven soil samples based on TCLP analysis. Four samples are classified as a RCRA hazardous waste due to the lead concentrations. These samples were collected at the 0-4 foot depth interval. Several soil samples also had low pH values. The elevated levels of lead and low pH values substantiate that a release of battery acid likely occurred. The present level of subsurface investigation has not defined the extent and degree of contamination.

Health and Ecological Risk Assessment: The area between Buildings 409 and 410 is scheduled for construction of a new building. There may be some risk to construction or utility maintenance personnel associated with contact with contaminated subsurface soils if they do not follow appropriate health and safety procedures. Based on similar levels of lead at DRMO. and the resulting risk for construction workers (Hazardous Waste Storage Building Construction), the risks at this site to unprotected construction workers could be above acceptable levels. The site is developed, therefore, there are no significant ecological risks.

8.1.6.2 Recommendations

It is recommended that this site proceed to the Step II phase of the IR program. Further subsurface soil investigation is recommended to characterize the extent of contamination in this area for possible remediation. A ground water quality investigation is also recommended to assess potential lead contamination, particularly in light of the low soil pH values, which may tend to make the lead more mobile. Should construction in the area be required, appropriate worker health and safety procedures should be developed.

8.1.7 Former Gasoline Station

8.1.7.1 Summary

Background: The former gasoline station site is located in the roadway and parking area just south of Building 164 (Dealey Center). The gasoline station operated from 1940 to the early 1960s. Several underground gasoline tanks and a waste oil tank existed onsite.

Nature and Extent of Contamination: The geophysical investigation identified the potential presence of one underground gas tank which appears to remain on the site. The soil gas survey did not detect the presence of significant VOC constituents, although organic vapor field measurements of subsurface soil samples indicated levels above background.

Five subsurface soil samples were collected from five test borings to screen for potential releases from the former gasoline station. Only one soil sample, located adjacent to the identified gas tank, contained VOCs. Trichloroethene and benzene were detected below TBC values. No metals exceeded established background concentrations, although three soil samples contained arsenic exceeding the TBC value based on TCLP analysis. The arsenic TCLP results do not appear significant, as arsenic concentrations do not exceed background values based on mass/weight analysis.

Health and Ecological Risk Assessment: No risks are identified under existing conditions based on available data. Appropriate health and safety precautions should be followed during tank removal to confirm that no contamination is present. The site is developed, therefore, there are no significant ecological risks.

8.1.7.2 Recommendations

It is not recommended that this site proceed to the Step II phase of the IR program. However, it is unlikely that the potentially identified underground gasoline tank was abandoned in accordance with current requirements (e.g., cleaning/filling with inert material). It is recommended that the tank be removed, and at the time of removal, confirmation soil samples be collected from the tank grave. **Samples should be collected from excavation sidewalls, at a depth just below the tank bottom and at the depth of the ground water table interface.** If no contamination is identified at that time, then no further action would be recommended at this site. **If contamination is detected, corrective actions should be taken in accordance with the underground storage tank regulations.**

8.2 Step II Sites

8.2.1 Area A/OBDA

8.2.1.1 Summary

Background: The Area A Landfill is located in the northeastern and north-central section of NSB-NLON. It is approximately seven acres in size. Access is via a dirt road off Wahoo Avenue. The Area A Landfill is a relatively flat area bordered by a steep, wooded hillside that rises to the south, a steep wooded ravine to the west, and the Area A Wetland to the north. Aerial photographs show that the landfill appears to have extended east along the wetland to as far as the present position of the tennis courts. Runoff from the landfill drains as overland flow north into the Area A Wetland, which subsequently discharges to the Area A downstream watercourses and into the Thames River.

The landfill opened sometime before 1957. The base incinerator ceased operating in 1963, and from 1963 to 1973 all wastes were disposed in the landfill unburned. During this time, all non-salvageable materials generated by the submarines and base operations were disposed in the Area A Landfill.

Landfilling operations ceased in 1973. After closure, a concrete pad was constructed in the southwest portion of the landfill for above ground storage of industrial wastes. At the time of the IAS survey, 42 steel drums, 87 transformers (mineral and PCB), and 60 to 80 electric switches were stored on the pad. Two transformers and several electrical switches were leaking. Past leakage of oil was also evident. Most drums were stacked on wooden pallets and those having PCB labels were covered and bound with plastic sheeting. All of these materials have since been properly disposed offsite.

Sand bags and contractors' supplies and equipment have, in recent years, been stored over the former landfill. Several transformers, removed underground storage tanks, crane weights, and other equipment are stored on the concrete pad in the southwest portion of the landfill. The specific items stored in this area vary. The remainder of the landfill is not paved.

The construction of a paved parking lot on the southeast end of the Area A Landfill was planned, but has been delayed indefinitely.

The <u>Area A Wetland</u> abuts the north side of the landfill and is approximately 30 acres in size. The maximum wetland sediment thickness is approximately 35 feet, based on boring information. Until 1957, this portion of the site was undeveloped, wooded land. In 1957, dredge spoils from the Thames River were pumped to this area and contained within an earthen dike that extends from the Area A Landfill to the south side of the Weapons Storage Area. Atlantic learned during the course of this study that, previously, pesticide "bricks" were placed on the wetland ice during winter and allowed to melt and discharge into the wetland for mosquito control.

Several construction projects are planned for the Weapons Storage Facility at the north end of the Area A Wetland. The facility was constructed partially on the dredged fill material and settlement has occurred in several areas. Routine maintenance and security improvements that are planned include grouting and waterproofing bunkers, repaving roads, and the installation of culverts and regrading associated with these activities. The Navy also plans to build more magazines and bunkers in this area within ten years.

The <u>Area A Downstream Watercourses</u> drain the Area A Landfill and Wetland and ultimately flow into the Thames River. The Area A Downstream Watercourses include North Lake and several small streams which discharge from Area A and the Torpedo Shop and ultimately discharge to the Thames River.

Ground water also discharges from Area A to a small wetland at the base of the dike and the Over Bank Disposal Area site. A stream flows from this wetland west toward North Lake, a recreational swimming area for Navy officers. Under normal flow conditions, the stream enters a culvert which bypasses the pond and discharges to a stream below the outfall of the pond. This stream flows west under Shark Boulevard and through the golf course to the Thames River. There is a manhole adjacent to North Lake, that connects to another pipe, which was designed to discharge overflow water from North Lake. Under substantial runoff conditions, however, it is possible that some water discharges to the pond from this stream.

Further development is not planned for this area.

<u>The Over Bank Disposal Area (OBDA)</u> is located on the slope of the dike below and adjacent to the Area A Landfill. A small wetland exists at the base of the dike.

This area was a disposal site after the earthen dike was constructed in 1957. In 1982, it was the finding of the previous studies that the material had been there for many years and included 30 partially covered 200-gallon metal fuel tanks and scrap lumber.

Atlantic personnel inspected the site in September 1988, and observed approximately 30 empty, unlabeled 200-gallon tanks, old creosote telephone poles, several empty unlabeled 55-gallon drums, and rolls of wire. Bright orange, organic sediments were observed in the water discharging from the base of the dike embankment, apparently leachate from the landfill.

<u>Area A Landfill - Nature and Extent of Soil Contamination</u>: A radiation, geophysical and soil gas surveys were conducted. No radiation above background was detected. The geophysical survey identified several suspected buried metal objects, which were avoided during

drilling operations. The soil gas survey detected VOCs, predominantly petroleum hydrocarbons, in the deployed parking area.

VOC concentrations in the subsurface soil within Area A Landfill are generally low. No TBC values for VOCs in soil samples were exceeded. One surface soil sample collected near the concrete storage pad did contain elevated levels of petroleum hydrocarbons. SVOs, principally PAHs, were detected at relatively low levels in some of the landfill subsurface soil samples. The results of the SVOs analyses at Area A Landfill are significantly lower than at the DRMO and Goss Cove former landfill sites. The organic results, in general, do not indicate significant disposal of organic chemicals within the Area A Landfill.

No PCBs were detected in the subsurface soils within Area A Landfill. One surface soil sample contained PCBs above the TBC concentration of 10,000 ppb. This soil sample was collected adjacent to the concrete storage pad where drum storage, PCB transformers, and electric switches were once stored. The potential extent of the PCBs in this area was not defined based on the two surface soil sample locations.

Pesticides were detected at three subsurface sample locations (2LMW7S, 2LMW8S, and 2LMW18S) at Area A Landfill. DDTR were detected at these locations at relatively low concentrations and are below TBC values. The DDT was present above the TBC value of 500 ppb at one surface soil sample near the concrete storage pad.

Out of the 12 subsurface samples analyzed by TCLP analysis procedures, ten contained one or more metals exceeding TBC values. Metals exceeding TBC values included arsenic, cadmium, lead, and selenium. TCLP hazardous waste characteristic values were not exceeded for any samples. Some inorganic constituents exceeded established background levels based on mass weight analysis, including beryllium, cadmium, lead, and mercury. Other metals exceeding background levels included copper, nickel and boron. The majority of these elevated metals are likely related to a past landfill disposal.

The lead and cadmium values are generally low, and are not indicative of the existence of a significant source such as the reported historical battery acid disposal in this area. Levels of cadmium, and particularly lead, were much higher at the Former Acid Storage and Disposal Site and DRMO, where battery acid storage tanks existed.

<u>Area A Wetland - Nature and Extent of Soil and Sediment Contamination</u>: VOC concentrations in the subsurface soil and sediment within Area A Wetland are in the low to moderate range. VOCs are generally spatially distributed throughout the wetland area and generally present at uniform concentrations with depth. This is consistent with the origin of the sediments, from the Thames River dredge materials, deposited in the wetland. VOC TBCs exceeded included benzene (one sample), trichloroethene (three samples) and tetrachloroethene (four samples). The source of the VOCs in the wetlands subsurface soils would appear to be associated with sediments originally contained from the Thames River, and/or absorption of ground water chemicals onto the sediments. The origin of the VOCs in the sediments could be from several sources, including those mentioned above, runoff from the Weapons Center, and

general urban runoff. The samples collected near the landfill did not contain any VOCs above TBC values.

SVOs, principally PAHs, were detected at generally low levels in most of the wetland sediment and subsurface samples. Overall SVO concentrations were slightly higher in the 0-2 and 10-22 feet reporting intervals, although this may be attributable to the smaller number of samples collected in the 2-10 foot interval. The highest concentration of SVOs was detected within a drainage swale at a stormwater discharge location of the Weapons Center. The Verification Study sediment sampling of another stormwater culvert discharge location near the Weapons Center also indicated the presence of PAHs. Sediment samples recently collected from the Thames River also contain low levels of PAHs, consistent with the levels in the Area A Wetland.

PCBs (Arochlor 1260) were detected at two sample locations, but were below the TBC value. The source of the PCBs in the wetland near the landfill appears related to transport of contaminated surface soils from Area A Landfill. The source of the PCBs detected at the Weapons Center is unknown.

Pesticides (DDTR) were detected at five sample locations in the 0-2 foot reporting interval. Based on detection in the 0-2 foot interval, these appear to be related to the past reported surface application of pesticides at the wetland area. The pesticide detections were less frequent and the concentrations much less than for the samples from the Area A downstream watercourses. This may be related to the potential for higher concentration of pesticides present at locations not sampled (pesticide bricks were reportedly applied at point locations), and/or due to compositing of the samples. This may be supported by previous sediment sampling conducted within the wetland near its outlet and at an upgradient location (east side), which contained DDTR in the 17,000 ppb range. Alternatively, it could indicate more substantial application of pesticides in the downstream watercourse area.

In general, metal concentrations within the wetland subsurface soil and sediment samples were low. A total of 35 soil and sediment samples were collected within the wetland proper, with the remainder collected at adjacent locations. Several samples contained slightly elevated levels of lead (7), mercury (3), cadmium (1), and silver (2). Several samples exceeded TBC values based on TCLP extraction procedure. These included arsenic, cadmium, chromium, lead, selenium, and silver. Only two samples had metal values (lead, silver) which exceeded both established background concentrations and TBC values based on TCLP analysis. The elevated metals are likely associated with the origin of the sediment from the Thames River. Cyanide was detected at the drainage outlet from the Weapons Center. The previous Verification Study also reported cyanide at another surface water discharge location from the Weapons Center. These detections of cyanide, and the elevated PAHs, suggest a possible source of contaminants at the Weapons Center. The elevated levels of cyanide and PAHs suggest that spent Otto fuel may be the cause of this contamination, however, the specific source is unknown.

Area A Downstream/OBDA - Nature and Extent of Soil and Sediment Contamination: The subsurface soil samples were collected at well locations which were in wooded undeveloped areas where no past disposal was reported or apparent. The exception was

3MW12S, which was located adjacent to the wetland at the Over Bank Disposal Area, where past disposal is evident.

Trichloroethene (24 ppb) and tetrachloroethene (58 pp) were detected at a subsurface soil sample location near North Lake, both of which are above TBC values of 5 ppb. Low levels of toluene and 1,1-dichloroethene were also detected. The source of the solvents detected near North Lake is unknown. One possibility is an unconfirmed report from a retired Navy employee who stated that there was a past disposal area in this general vicinity. This could not be confirmed based on review of aerial photographs and discussions with other Navy personnel.

No SVO compounds were detected in subsurface soils, except for low levels of phthalates at one sample location. Low levels of SVOs, principally PAHs, were present in a subsurface soil sample at OBDA, which correlates with SVOs detected in the sediment samples at OBDA.

No PCBs were detected in the subsurface sample points. Pesticides, DDT and its derivatives, were detected in a subsurface soil sample near OBDA and at a sample near North Lake. The detection of pesticides at these locations appears related to past pesticide application in Area A. No significant detections of inorganics were noted in the subsurface soil samples.

Twenty-three sediment samples were collected for analysis from the OBDA wetland, the Area A downstream watercourses and associated ponds, and North Lake. The purpose of the sediment sampling and analysis programs was to assess the extent of sediment contamination (principally pesticides) within this area, due to past application and sediment transport from potential source areas. Previous analysis of sediments in this area indicated the presence of pesticides and metals.

No VOCs were detected above TBC values for samples collected. At sample locations near the outlet of Area A wetland, low levels of VOCs (methylene chloride, trichloroethene) were detected, indicating some limited migration of VOCs via sediment transport from Area A wetland. Within OBDA, all sediment samples contained low levels of VOCs, but below TBC values. VOCs detected include methylene chloride, 2-butanone (methyl ethyl ketone), tetrachloroethene, toluene, ethylbenzene, and xylene. This indicates that some past releases of solvents and petroleum hydrocarbons occurred at the OBDA site. These VOCs could also be partially attributable to adsorption of chemicals to the sediments from ground water. Low to moderate levels of SVOs were detected in most sediment samples.

The only detection of PCBs was at 2DSD12, which is at the outlet of the downstream watercourse, at the Thames River, adjacent to DRMO. Based on the elevated levels of PCBs at the DRMO site, it appears likely that this is associated with surface water runoff from the DRMO site and not Area A.

Pesticides (DDTR) were detected at moderate to very high concentrations within the Area A downstream watercourses and ponds. No pesticides were detected in the North Lake sediments. The TBC value was exceeded at ten of the 23 sample locations. The highest concentrations were detected in the two ponds below the Area A dike, and within the OBDA sediments. Based on these concentrations being much higher than those found within Area A wetland, this may be due to pesticides application rather than sediment transport. High concentrations in these areas suggest that substantial quantities of pesticides were applied in this area. Lower concentrations downstream of these areas and extending to the Thames River are likely attributable to sediment transport from the higher concentration areas. The data indicates that some ongoing migrations of pesticides, due to sediment transport, to the Thames River is occurring from the pond source areas.

Several metals were detected above established background levels. These occurred in samples closest to the Area A wetland area. They included beryllium, cadmium, lead, selenium, zinc and boron. Cadmium was not detected above background levels in the Area A wetland sediments, therefore, the cadmium source does not appear to be related to sediment transport from the wetland. No metals were detected above background levels in North Lake sediments.

Ten sediment samples were collected from the OBDA area. Sediment samples contained metals above established background levels for cadmium (3), iron (2), lead (4), selenium (2), and zinc (2). Cadmium results based on TCLP analysis correlated with mass weight analysis for two samples. TCLP analysis detected no lead. The elevated iron concentration may partially explain the rust colored leachate that is visible in this wetland area and within the stream bed. The lead and cadmium may suggest battery/battery acid disposal in this area, which were the highest concentrations recorded throughout Area A. Alternately, it could be related to the cadmium present in the ground water at this location, and adsorption onto the sediments as it discharges to OBDA.

Area A - Nature and Extent of Ground Water Contamination: Twenty-eight ground water monitoring wells were installed and sampled within Area A, which includes the landfill, wetland, and downstream areas. Eleven were water table overburden wells and 17 wells were installed and screened in the bedrock aquifer.

VOCs were detected in only six of 28 monitoring wells within Area A. Of the six, only three locations exceeded TBC/ARAR values for drinking water. The solvent trichloroethene was detected above drinking water standards (ARARs) at 2LMW13D (10 ppb) at the west end of the landfill, and 2DMW16D (17 ppb) upgradient of North Lake. These are both bedrock wells. This suggests a low concentration plume of solvents within the bedrock aquifer extending from the western portion of the former landfill downgradient to the North Lake area. The ground water does not appear to discharge to North Lake, based on the vertical head gradient information at 2DMW16S&D. The plume appears to be fairly narrow, as no solvents were detected in the Area A downstream wells to the north. This is supported by review of the ground water specific conductivity data which is used as a landfill leachate indicator. Solvents were not detected in downgradient well 3MW12D (OBDA), suggesting preferred fracture flow is occurring in the bedrock aquifer. However, this does not correlate with the cadmium data, which indicated elevated levels of cadmium at 2LMW13S and 3MW12D. The downgradient extent of the solvent plume is undefined, which is flowing in a westerly direction. Benzene was detected at 10 ppb, above drinking water standards (5 ppb) at 2LMW18S, which may be related to the parked vehicles in this area; it was not detected in any other well in Area A.

Overall, the VOC concentrations for those wells where detected are low, given the historical use of Area A as a landfill. Although drinking water ARAR/TBC values are exceeded in three wells, the results do not indicate any significant ongoing release of VOC contaminants.

Based on the soil gas and subsurface soil data, low levels of petroleum hydrocarbons and solvents are present throughout much of the Area A landfill area. This suggests a generally uniform-low level of soil contamination within the landfill, and no substantial source area. The deployed parking area and adjacent area to the east (also used for automobile storage/parking) exhibited the most uniform level of petroleum hydrocarbons based on soil gas data.

PCB was detected in the ground water at one location within the landfill. The concentration exceeded its solubility and further sampling of the well would be required for confirmation of the result.

Cadmium was the only inorganic compound which exceeded primary drinking water standards (ARARs) within Area A. Cadmium was also detected in one instance above drinking water standards at a residential well located east of Area A. Cadmium was detected above the 5 ppb drinking water standard at 2LMW18D (7.2 ppb), 2WMW3D (7.7 ppb), 2WMW5S (6.4 ppb), 2WMW3S (10.6 ppb), 2LMW18S (29.1 ppb), 2LMW13D (44.8 ppb), and 3MW12D (16 ppb). The source of these elevated levels of cadmium may be related to soils within the landfill and, possibly, OBDA. However, cadmium soil concentrations in the landfill only exceeded established background levels at one sample location (2LMW8S). It is possible that higher concentrations of cadmium exist in the landfill, at locations other than the sample points. Dissolved cadmium levels in Area A ground water may be partially attributable to low pH values for some wells. The upward ground water vertical head gradient within most of the landfill should minimize the transport of cadmium to the bedrock aquifer from an apparent landfill source. However, at bedrock well 2LMW13D, where there is a strong upward vertical head, the cadmium is present in the bedrock system, from a source either upgradient within the landfill, or another unknown upgradient source. The former Weapons Center is upgradient of this area along Wahoo Avenue, however, the lack of elevated levels of cadmium in other nearby bedrock wells (2LMW9D, 2LMW17D, and 2LMW14D) does not strongly support an offsite source, but rather a landfill source.

The overburden ground water flow along the central and eastern portion of the landfill is toward the wetland, and along the western portion of the landfill to the northwest, down the Area A downstream watercourse valley. Therefore, the cadmium ground water contamination appears confined to the landfill and the OBDA area. Cadmium was only detected in well 3MW2D in the OBDA, suggesting a potential confined plume to the northwest although, due to preferred bedrock flow patterns, other wells may not have intercepted the cadmium and, therefore, the cadmium plume may be undefined.

Of importance to this study is the direction of bedrock ground water flow in this area, due to the detection of cadmium in several offsite residential wells to the east of Route 12. Inspection of the bedrock ground water contour map indicates that the residential wells along Route 12, Baldwin Hill Road and North Pleasant Valley Road are upgradient of Area A, and would not be affected by conditions at the site. Most of these wells had bedrock ground water elevations substantially higher than wells containing cadmium in Area A (2WMW3D, elevation 76 feet). However, residential wells near the NSB-NLON east gate, southeast of Area A, had bedrock water elevations (75-80') in the same range as 2WMW3D, the closest bedrock well in Area A. Therefore, based on the available data, it is indeterminate if these wells are upgradient or downgradient of the western portion of the Area A Landfill, however, cadmium does not exceed drinking water standards in these wells.

Iron and manganese exceeded secondary drinking water standards in many Area A wells. The results for 2WMW1D and 2WMW2D (upgradient wells) and the residential well analytical results were much lower for iron and manganese, which indicates a source of these inorganics within the Area A landfill material and wetland sediments.

Radiological screening parameters were exceeded in nine of the 20 samples. These occurred at three within the landfill area; one near the Weapons Center; and four within the Area A downstream area. These elevated readings could be the result of naturally occurring radioisotopes which do not meet the gross screening criteria. Further sampling and analysis is required for confirmation.

Residential Well Analytical Results: A residential well sampling and analysis program was conducted to assess ground water quality in offsite areas near Area A.

The first round sampling indicated low levels of chloromethane, methylene chloride, and xylene at OSW15 (16 Sleepy Hollow), but below drinking water standards. This well was resampled for VOCs in the second round and none were detected. The first sampling round indicated the presence of cadmium at OSW6 (1458 Route 12) above primary drinking water standards (10 ppb) at a concentration of 26.3 ppb. Other compounds (iron, manganese, aluminum and sodium) were detected in other wells which exceeded secondary drinking water standards, and are attributable to natural ground water conditions.

Due to the presence of cadmium, second and third sampling rounds were conducted to expand the sampling program to areas east of Area A on Route 12, North Pleasant Valley Road, and Baldwin Hill Road. The second and third sampling rounds did not detect any metals above primary drinking water standards. Also, cadmium was not detected at 1458 Route 12, where it was previously present. Cadmium was detected at low levels at five of 13 wells sampled in the 2.1-3.1 ppb range, below the 10 ppb standard. As previously discussed, an assessment of the ground water hydrogeology of this area indicates that the presence of cadmium in the offsite residential wells is not attributable to the detection of cadmium within Area A at NSB-NLON, with the possible exception of well OS25 to the southeast, which contained cadmium below standards, but could be downgradient of Area A Landfill.

The cadmium detected within the residential sample area appears to be a natural background concentration in the ground water. A further round of residential well sampling is planned to further confirm the analytical results.

Boron was found in all residential wells above the TBC value of 600 ppb, which is based on an EPA health advisory. Concentrations of boron ranged from 770 to 2,000 ppb. The source of this boron is unknown.

Nature and Extent of Area A Surface Water Contamination: Fifteen surface water samples were collected within Area A, including the wetland, downstream areas and Thames River. These samples were collected to assess the surface water quality.

Low levels of VOCs were detected at several sampling points 2DSW5, 2DSW7, 2DSW8, 2DSW12, and 2DSW13. Except for one sample, constituents detected are petroleum hydrocarbons and could be associated with runoff. One sample near Triton Avenue contained 3 ppb of tetrachlorethene and 2 ppb of styrene. No ARARs or TBCs were exceeded for the VOCs. No SVOs were detected at any of the sampling locations.

No pesticides or PCBs were detected at any of the sampling points except for 2DSW4, which contained 1.9 ppb of DDD. This sample is in the area where high levels of DDTR, including DDD, were detected in sediments. It is likely that the origin of DDD in the surface water is from the sediments.

ARARs/TBCs for inorganics were exceeded at several sample locations for cadmium (3 of 15), copper (15 of 15), iron (11 of 15), lead (11 of 15), manganese (13 of 15), zinc (14 of 15), and mercury (1 of 15). These ARARs are based upon in-stream water quality criteria and standards to protect aquatic life and may not be appropriate to the wetlands and small drainage streams. The presence of iron and manganese in surface water may be a result of the low pH and reduced conditions created by the Area A Landfill. Some of the iron and manganese may originate from wastes, however, the majority of what is detected in surface water is probably being leached from native soils. Of note are the ARAR exceedances in the Thames River at sample locations 2DSW12 for manganese and iron, and at 2DWS13 for manganese. Area A upstream surface water samples also contained elevated levels of iron and manganese, whereas surface water samples in the Thames River at DRMO and Goss Cove did not contain levels above ARARs. The iron standard of 1000 ppb is based on chronic aquatic toxicity water quality criteria and the manganese standard is based on water quality criteria for human health risks from fish consumption.

Copper and zinc, which exceeded water quality criteria or standards, were also detected in concentrations above background in soils at the Area A Landfill soils. It is assumed that the elevated concentrations originate from the Area A Landfill.

Cadmium and lead are present above ARARs and levels normally seen in natural surface waters and are present both in the Area A wetlands and landfill soils and sediments. The presence may be the result of historical disposal activities. However, cadmium and lead were also detected in the upgradient sample location (2LSW1) above ARARs.

Mercury was only detected in one surface water sample (2DSW9). This location (adjacent to Triton Road) is immediately downgradient of two sediment sampling locations where mercury was found. Although these two sediment mercury concentrations were below background, mercury was not detected in any other sediment samples. There was one occurrence of mercury above background concentrations in Area A Landfill soils. Mercury is rarely found in natural surface waters above 1 ppb. The source of the mercury in sediments is not apparent, however, historical disposal in Area A Landfill is possible. However, it is more likely that a past release upgradient of sample locations 2DSD7 and 2DSD8 along Triton Road occurred. It is noted that sediment sample 7SD1, within a runoff swale from the Torpedo Shop, contained no mercury, nor did any other soil or ground water sample at the Torpedo Shop, which implies that the Torpedo Shop is not the source.

All of the radiological results were below ARAR screening values.

Human Health Risk Assessment: Several identified exposure pathways were evaluated for Area A. They are listed as follows:

- Workers repairing utilities within Area A;
- Weapons Center personnel exposed to fugitive dusts from Area A Landfill:
- Workers moving pallets within Area A Landfill;
- Navy personnel exposed to fugitive dust while engaged in recreational activities near Area A Landfill;
- Groton/Ledyard residents exposed to fugitive dust from Area A Landfill;
- Citizens attending car auctions at Area A Landfill;
- Subase children exploring woods within Area A;
- Subase children exploring streambeds and Area A Wetland; and
- Children swimming in North Lake.

Negligible or *de minimus* risks were calculated for workers repairing utilities within Area A, Weapons Center personnel exposed to fugitive dust, Navy personnel exposed to fugitive dust while engaged in recreational activities, citizens attending car auctions, and children swimming in North Lake.

The following exposure scenarios did exhibit risks which fell within the one in one hundred thousand to one in one million excess cancer risk range:

- Workers moving pallets within Area A Landfill (risk due to presence of PCBs in landfill surface soils);
- Subase children exploring woods within Area A (risk due to PCBs in landfill surface soils); and
- Subase children exploring streambeds and Area A Wetland (risk due to pesticides in stream sediments).

Ground water within Area A contains VOCs and cadmium above ARAR and TBC drinking water standard/guidance values, indicating a potential health risk if the water were to be consumed. No potable water supply wells exist, or are planned by the Navy, in the potentially affected downgradient area. The Navy owns the land within the potentially affected area. Therefore, under existing and projected future land use conditions, no exposure pathways exists for human consumption of degraded ground water.

__Ecological Risk Assessment__: The ecological risk assessment addressed risks to a variety of trophic levels in the terrestrial and aquatic food chain in Area A. On the lower level of the food chain, risks to plants were low. Plants are unlikely to accumulate organic compounds to a great degree. Metals concentrations in soils and sediments were, in general, below levels that may adversely affect plants or higher trophic level organisms that feed on plants. However, cadmium concentrations in soil samples from the OBDA exceeded recommended levels protective of plants and organisms consuming plants.

Risks to terrestrial organisms due to DDTR in soil were greatest for soil invertebrates in the OBDA. The risks to soil invertebrates in the wetland and downstream areas due to contaminants were low.

The assessment indicates that DDTR in sediments of streams and ponds in the Downstream Watercourse Area poses a potentially great risk to biota. Organisms with the greatest exposure to DDTR contaminated sediments are benthic invertebrates. Frogs are also directly exposed to sediment during winter months. Other organisms potentially affected by these sediments are fish, if they are present in the ponds. Birds such as ducks, heron, and mammals such as raccoons and otter, may be exposed to DDTR by feeding on contaminated aquatic invertebrates and frogs, but this exposure will only account for a small part of their diet because they are likely to feed over a much greater geographical area than Area A.

Higher level organisms in the food chain may be exposed to the DDTR and, to a lesser extent, to PAHs bioaccumulated in soil invertebrates. The greatest potential risks are to small mammals such as the shrew that consume a diet consisting mainly of soil invertebrates at a rate equivalent to their body weight per day. Based on the assumption that they consume only contaminated soil invertebrates, there are potential risks to these animals. Risks to herbivorous birds and small mammals are much smaller than for the maximally exposed shrew since they have much less exposure to DDTR. Based on the low body burdens of DDTR in catbirds collected from Area A, risks to birds feeding on soil invertebrates appear to be low. This may be because the area they feed in is large in comparison to the portion of the OBDA with elevated levels of DDTR in soil.

The aquatic organisms in Area A at greatest risk are those exposed to elevated levels of DDTR in pond and stream sediments in the Downstream Watercourse Area. Therefore, benthic invertebrates and possibly frogs are at greatest potential risk. DDTR contaminated sediments have been transported by the streams in the downstream portion of Area A to the Thames River. However, DDTR concentrations and, therefore, potential risks due to DDTR are much lower at the stream outfalls than upstream.

8.2.1.2 __Recommendations__

It is recommended that this site proceed to the Feasibility Study phase to address the health and ecological risks identified. Additional data is recommended to be collected concurrent with the Feasibility Study to further assess several site conditions for input to the FS. Recommendations and data requirements are provided below.

Landfill Soils

- Further soil sampling is recommended around the Area A concrete pad (former hazardous waste storage area) to define the full extent of contamination identified in that area.

Wetland Sediments

- Further sediment sampling is recommended in the Area A Wetland to confirm the relatively low levels of pesticides detected compared with Area A Downstream sediments. Sampling in the pond and open water area near the wetland outlet is also recommended. These data are required for the Feasibility Study and further ecological assessment. The pond information would better allow assessment of risks to biota in these areas and to compare measured body burdens of DDTR in frogs from the wetland pond to sediment DDTR concentrations.

Ground Water

- Conduct another ground water sampling and analysis round for TCL organic and TAL inorganic parameters to confirm the analytical results. Also, perform specific radiological isotope ground water analysis to determine the source of the radiological constituents (natural or otherwise).

- The extent of VOC and cadmium ground water contamination in Area A Downstream should be defined and monitored.

- Further assessment of the ground water flow direction in the area of the southeastern portion of the landfill is required with respect to the homes served by private wells near NSB-NLON east gate. This would require the installation of additional monitoring wells in this area, and surveying the elevation of the water in the private wells.

Residential Wells

- **A further investigation of the sources of boron in residential wells is recommended.**

Weapons Center

- Further assessment of the source of elevated levels of cyanide and PAHs adjacent to the Weapons Center is recommended.

North Lake

- Surface soil sampling around the North Lake area is recommended to determine if contamination is present due to past pesticide application in the general area. This is recommended to assure the safety of use of North Lake as a recreational area. Continued monitoring of North Lake is recommended should the lake remain open for public use. Should the lake remain open, access to the downstream watercourse areas should be restricted.

- **Long-term ground water elevation monitoring is recommended in this area to better determine ground water flow directions.**

- **The overflow pipe from North Lake to the stream which flows to the south of North Lake will be eliminated to prevent the possibility of water from the stream discharging into North Lake.**

Downstream Watercourses and Pond

- The ecological assessment was based on a limited number of surficial soil samples from the Area A Downstream Watercourse Area. At the time of designing the sampling program, it was unknown that DDTR levels would be the most elevated in this area. To gain a greater level of confidence in this assessment, we recommend additional surficial soil sampling and analysis in the downstream watercourse area.

- Additional information is required on biological conditions in the Area A Downstream Watercourses where elevated levels of DDTR were detected in pond and stream sediments. No biota sampling was performed in these areas. The assessment predicts risks to benthic invertebrates and possibly to frogs in these areas. To supplement this assessment with actual field data, additional field work is recommended to assess the biological community in the ponds and streams where DDTR was detected at elevated levels in sediments.

Thames River

- Pesticides are being transported to the Thames River. Although the levels in the river sediments detected to date are not high, further delineation is recommended to further evaluate this condition. Manganese has also been detected in the Thames River surface water samples at the outlet of Area A in concentrations above water quality criteria. In light of these facts, further ecological assessment of the Thames River, similar to that recommended at Goss Cove, DRMO, and Lower Subase is recommended to provide greater assurance regarding the current assessment of ecological risks. This assessment should consider the potential cumulative effects of NSB-NLON on the river.

8.2.2 DRMO

8.2.2.1 Summary

Background: The Defense Reutilization and Marketing Office (DRMO) site is adjacent to the Thames River in the northwest section of NSB-NLON. The DRMO is the storage and collection facility for items to be sold at auction sales held periodically through the year. Scrap metal is also temporarily stored prior to being transported off this site.

The DRMO site was used as a major base landfill and burning ground from 1950 to 1969. The materials burned and landfilled included construction materials, combustible scrap, and other non-salvageable waste items. These materials were reportedly burned on the shoreline, and disposed over the riverbank and partially covered. Also, a former battery acid handling facility was located adjacent to Building 491. An in-ground rubber-lined tank and associated pumping facilities were present, similar to the Spent Acid Storage and Disposal Area site.

DRMO operations at this site, after the closing of the landfill, include storage of various items, including submarine batteries, white goods, and empty drums.

Future plans for this site include the construction of a Conforming Storage Facility for the temporary storage of hazardous waste generated at NSB-NLON. Other routine grading and minor excavation occurs in the northern portion of the site.

Nature and Extent of Contamination: Radiation, geophysical and soil gas surveys were conducted. No radiation above background was detected. The geophysical survey identified several suspected buried metal objects, which were avoided during drilling operations. The soil gas survey assisted in defining VOCs in several areas.

Twenty-four soil samples were collected, from 12 test boring/monitoring well locations. Four surface soil samples were also collected. Six ground water samples were also collected and analyzed. These samples were analyzed to define the nature and extent of contamination at the former landfill site.

Some evidence of the former landfill was encountered during the drilling, including wood fragments, brick, metal, but predominantly earth fill material. The depth of fill varied from zero to eight feet.

VOC concentrations in soil at DRMO are generally low. However, many soil samples exceed TBC values for VOCs. Elevated VOCs were detected at 6TB4 (6-8'), where the following was found: vinyl chloride (1300 ppb), trichloroethene (20,000 ppb), and tetrachlorethene (210 ppb). The contamination appears to be generally isolated at the site based on results of the soil gas survey and other soil samples collected in this area.

SVOs were present in most samples collected in the former landfill area. The SVOs were predominantly comprised of PAH compounds, many of which were at elevated levels. The spatial density of the sample locations indicates that PAHs are likely present throughout the

DRMO site limits. Based on the former use of the site as a landfill, and an area where material was burned, the PAHs are likely a result of incomplete combustion and, perhaps to a lesser degree, due to petroleum releases.

PCB Arochlor 1260 is present at almost all sample locations except 6MW5S (background), and 6MW1S and 6MW2S (rear of office and storage building). Concentrations range from 52 ppb to 12,000 ppb. It is generally present in both the 0-2' and 2-6' depths. The presence of PCBs at this site is most likely associated with scrap metal storage (e.g., white goods) and associated capacitor leaks, and past storage of transformers, and not necessarily due to landfill disposal. PCB (Arochlor-1260) was also detected at sediment sample location 2DSD12, at the outfall of the storm drainage system from Area A, to the rear of Building 397 at DRMO. It was not present in other upgradient sample points along the Area A downstream watercourses, and may be a result of surface soil transport via surface water runoff from DRMO.

Pesticides were detected at one sample location at elevated concentrations; no other pesticides were detected at other sample locations. Total pesticide concentration was 57,800 ppb, consisting of DDT, DDD and DDE. The DDT concentration was detected above the TBC value. Due to pesticide detection at only one sample location and at a depth of 2-6 feet, it was likely associated with past landfilling rather than application.

Out of 24 samples analyzed for TCLP metals, 21 contained one or more metals exceeding TBC values. Metals exceeding TBC values included barium, cadmium, chromium, lead, mercury and silver. TCLP hazardous waste characteristic values were exceeded for lead (5 ppm) at 6MW3S (2-4') 52 ppm, at 6TB5 (2-6') 32 ppm, and at 6SS3 (0-0.5') 6.2 ppm. Lead values were generally elevated around Building 491 (former battery acid handling), indicating battery acid releases occurred in this area. Many inorganic constituents exceeded established background levels based on mass weight analysis. These included antimony, beryllium, cadmium, cobalt, copper, lead, mercury, nickel, zinc and boron. The majority of these elevated metals are likely related to a combination of past landfill disposal and scrap metal storage.

No petroleum hydrocarbons were detected in the ground water samples. Trichloroethene and 1,2 dichloroethene were present in three downgradient wells (6MW2S, 6MW3S, and 6MW4S). Trichloroethene exceeded the ARAR value (5 ppb) with a concentration of 8 ppb at well 6MW4S. The primary source of the solvents in the ground water, based on the soil analytical results and the soil gas data, is projected to be in the area of 6TB4, 6MW4S, 6TB6 and 6TB7.

No SVOs, PAHs, pesticides or PCBs were detected in any wells at the DRMO site. Low levels of phthalates and benzoic acid were detected in the upgradient well 6MW5D. The inorganic ground water analysis results indicate that selenium exceeds the primary drinking water standards (ARARs) at wells 6MW2S, 6MW3S, and 6MW4S. The cause of the selenium levels in the ground water is unclear, but appears to be site related. Radiological screening values were exceeded in two of the ground water sample locations for gross beta. The elevated readings could be the result of naturally occurring radioisotopes which do not meet the regulatory screening criteria, but further analysis is required for confirmation.

No VOCs, SVOs, pesticides, or PCBs were detected in the upgradient surface water sample. Comparison of the inorganic results for this sample with the downgradient water sample (Goss Cove) did not suggest any detectable impact on the Thames River from NSB-NLON based on this limited data set.

Human Health Risk Assessment: Several identified exposure pathways were evaluated for Area A. They are listed as follows:

- Citizens attending auctions and public sales at DRMO;
- Navy workers sorting scrap metal;
- Workers repairing/installing utilities;
- Construction of a Hazardous Waste Storage Facility; and
- Exposure to fugitive dust from DRMO.

Negligible or *de minimus* risks were calculated for Citizens attending auctions and public sales, Utility workers repairing/installing utilities, and Exposure to fugitive dust from DRMO. The following exposure scenarios did exhibit risks which fall within the one in ten thousand and one in one million excess cancer risk range:

- Navy workers sorting scrap metal (risk due to PCBs, PAHs, and beryllium in surface soils); and

- Construction of a Hazardous Waste Storage Facility (risk due to elevated level of lead at northern portion of site).

Although ground water quality exceeds drinking water standards, no drinking water wells are within the affected area, nor could they be due to the proximity of the brackish Thames River.

Ecological Risk Assessment: Ground water from this site discharges to the Thames River. Based on the available data, contaminant concentrations in ground water are predicted to be below water quality criteria after further dilution in ground water, attenuation due to adsorption to soils, and dilution in the Thames River estuary. Risks to fish due to contaminants in ground water discharge from these sites are expected to be low.

8.2.2.2 Recommendations

It is recommended that this site proceed to the Feasibility Study phase. In the interim, specific health and safety provisions are recommended for all future subgrade construction projects at the site. Prior to construction in specific site areas, further subsurface investigation may be required to characterize the quality, health and safety, and potential disposal requirements of the material. The geophysical survey indicated the presence of buried metal objects at three locations as defined in Section 4.0. Any future construction planned near these areas should include exploratory excavation to identify health and safety construction requirements.

Due to the potential risks to site workers resulting from contaminated surface soils. it is recommended that worker health and safety procedures be developed to mitigate this risk. The risks are primarily related to incidental oral and dermal exposure. It is suggested that coveralls and gloves be worn during these activities and that hands be cleaned following working.

The following additional data requirements are recommended to be developed during the Feasibility Study phase.

1. Further environmental risk assessment of the potential impact of the site on the Thames River should be conducted, to verify that the impacts are negligible. This would include surface water samples at low tide (ground water discharge conditions), sediment sampling, and biota survey/sampling along the Thames River shoreline.

2. Conduct another ground water sampling and analysis round for TCL organic and TAL inorganic parameters to confirm the analytical results. Perform specific radiological isotope ground water analyses to determine the source of the radiological constituents (natural or otherwise).

8.2.3 Lower Subase

8.2.3.1 Summary

Background: The Lower Subase is located along the western edge of NSB-NLON, adjacent to the Thames River. It is bounded by the Thames River to the west and by the Penn Central Railroad to the east. The Lower Subase is the original subase and, therefore, its history dates back to 1867. Most of the construction took place in the early 1900s with major expansion between 1935 to 1945. Extensive portions of this area have been filled. The Lower Subase has always been used for operations and maintenance functions. Those functions typically generate industrial and hazardous wastes such as petroleum oils and cleaning solvents. Also located at the Lower Subase are two sets of concrete underground storage tanks located at the northern end of the study area. Four USTs are located just north of the powerhouse, and seven USTs are located just south of Building 107. In addition, there is an extensive underground fuel oil and diesel oil distribution system at the Lower Subase.

Previous investigations (NESO, 1979 and Wehran, 1987) have identified subsurface oil contamination associated with both sets of underground storage tanks, a waste oil pit in Building 79, in which historically, diesel train engines were serviced, and the underground fuel oil distribution system.

The Navy has implemented a substantial program to replace these underground tanks and the fuel oil distribution system. Of the ten concrete underground storage tanks, six now serve as spill contaminant for new steel tanks, three have been properly abandoned, and one is out-of-service. The Navy, while retrofitting or abandoning these tanks, did not detect any major structural defects or cracks. The underground #6 oil lines will be abandoned in the future based upon present Navy plans. All of the subsurface #2 oil lines, which are direct buried, were replaced or installed in 1980.

Nature and Extent of Contamination: To determine the extent and degree of contamination at the Lower Subase, investigations included the installation of 17 new wells and five soil borings. Soils from the five soil borings were only field screened for contamination. Soil samples were collected from all monitoring well installations. Ground water from all 17 wells and seven existing wells were sampled. All soil and ground water samples were analyzed for TCL volatile organics, TAL inorganics, total petroleum hydrocarbons, and fluorescence "fingerprint" analysis. In addition, soils were also analyzed for TCLP metals.

The following findings and conclusions are provided.

- Ground water at the Lower Subase is relatively clean with only slight exceedances of ARAR values at six locations. VOC standards were exceeded at 13MW2 and 13MW13, and metal standards were exceeded at 13MW8, 13MW9, NESO10 and NES011. These ARARs are based on standards for drinking water.

- No free product was detected in the subsurface, other than very thin layers in 13MW5 and MH83. No oil releases were observed along the bulkhead at the Thames River.

- A large area of subsurface soil near of Building 29 contains petroleum hydrocarbons which apparently originate from both sets of underground storage tanks. Although petroleum contamination is evident, no ARAR/TBC values for soils are exceeded.

- Ground water near Building #29 had a pH ranging from 9-11. This high pH is indicative of an ongoing release, and is apparently due to the discharge of boiler blowdown to the subsurface.

- A smaller area of subsurface soil adjacent to Building 79 contains petroleum oils and low levels of organic solvent. TBC values for organics are only slightly exceeded at one sample location 13MW13. The apparent source of this contamination is the former onsite oil pit in Building 79.

- Low levels of petroleum products are ubiquitous in the Lower Subase soils and ground water. The apparent source of this contamination is the accumulation over the years of minor spills and leaks.

- Elevated lead levels in soils were detected in several locations scattered across the site. Of these, two locations had TCLP lead levels high enough to classify the soils as a hazardous waste (13MW11 and 13MW15). The lead contamination may have resulted from former lead-acid battery management operations that used to be performed at the Lower Subase. Lead was not detected in ground water above ARARs.

- The subsurface free product detected in previous studies is no longer present. It is concluded that some of this oil has migrated to the Thames River, and the remainder has been adsorbed to soils.

- Low levels of thallium were detected in ground water at wells 13MW15 and 13MW16.

Human Health Risk Assessment: Several identified exposure pathways were evaluated for the Lower Subase. They are listed as follows:

- Utility workers exposed to soils and ground water in utility vaults;

- Utility workers exposed to soils and ground water during utility excavation work;

- Future construction of buildings in Lower Subase; and

Negligible or *de minimus* risks were calculated for these exposure scenarios.

Although ground water quality exceeds drinking water standards in a few wells, no drinking water wells exist in the affected area, nor could they due to the proximity of the site to the brackish Thames River.

Ecological Risk Assessment: Ground water from the Lower Subase discharges to the Thames River. Based on available data, contaminant concentrations in ground water are projected to be below water quality criteria after further dilution in ground water, attenuation due to adsorption to soils, and dilution in the much greater flow (compared to ground water flow) in the Thames River estuary. Risks to aquatic life due to contaminants in ground water discharge from these sites are expected to be low.

8.2.3.2 Recommendations

It is recommended that this site proceed to the Feasibility Study phase.

The following additional data requirements are recommended to be developed during the Feasibility Study.

- Further subsurface soil sampling with testing for total and TCLP lead should be performed in areas of elevated lead levels in soils to define the extent of soil that is classified as a hazardous waste.

- Conduct another ground water sampling and analysis round for TCL and TAL parameters detected to confirm analytical results and TCL SVOs to confirm the assumptions made in the risk assessment. The risk assessment estimated SVO concentrations based upon total petroleum hydrocarbon concentrations.

- A health and environmental risk assessment of the potential impact of the site on the Thames River should be conducted, to verify the qualitative assessment that impacts are negligible. This would include surface water samples at low tide (ground water discharge conditions), sediment sampling, and potentially biota survey/sampling along the Thames River shoreline.

- A testing program should be developed for the buried #2 fuel oil lines (installed in 1980) to insure that they are not leaking and do not leak in the future.

- The abandonment of the #6 oil lines should be done in a manner to prevent any future subsurface release of #6 oil.

- The one tank (H) that is out-of-service should be properly abandoned.

- The apparent release of boiler blowdown to the subsurface at Building #29 should be investigated and corrected.

Weapons Center
Site Description

The Weapons Center site consists of Building 524 and the weapons storage bunkers. The storage bunker area is divided into two portions (north and south areas), each constructed at different times and of different design. The site is located at the end of Triton Avenue to the north and adjacent to the Area A Wetland. A site plan is shown in Figure 2-12 and Plate 1. Building 524 is only shown in Plate 1.

The Weapons Center (Building 524) is located near the top of a bedrock ridge. The building was constructed in 1990-1991. Portions of the site were blasted to remove bedrock to allow construction of the building. The bunkers are located south and downhill of Building 524 adjacent to and at a slightly higher elevation than the wetlands. Surface run-off from the bunker storage area flows to the wetlands via overland flow in small grassed swales and drainage culverts.

Prior to construction of the Weapons Center, the site consisted of woodlands in the area of Building 524 and wetlands in the bunker areas. Based upon a review of aerial photographs, the southern group of storage bunkers are first evident in a June 1, 1969 aerial photograph and the northern group of storage bunkers are first evident in a photograph dated February 24, 1974. Building 524 is first evident in a photograph dated May 30, 1991.

Atlantic inspected the Weapons Center, accompanied by Lieutenant Commander Fyvie, on September 11, 1992. The following information was obtained during the site inspection. Building 524 is used for administration, minor torpedo assembly, and storage of simulator torpedoes. No weapons production takes place in this building. Small quantities of chemicals and chemical waste generated by activities in this building are stored in 1 to 5 gallon containers in seven metal storage cabinets located on a paved area to the south of the building. Chemicals include cleaning and lubricating compounds, paints, and adhesives. Many of these materials are classified as corrosive or flammable materials. The waste storage and management practices appeared good.

The weapons storage bunkers are south of Building 524. Liquid fuels in the weapons include Otto fuel, JP-10, and TH Dimer (kerosene). The group of bunkers to the south have recently been reconstructed. A major part of this reconstruction involved removal of structurally unsuitable soil from the site. The materials removed appear to be dredge spoils from the Thames River deposited in the wetland. Prior to offsite disposal, these materials and excavation sidewalls and ground water were tested. The following samples were collected: one sample of ground water from within the excavation; two soil samples from excavation sidewalk (one above and one below the water table); and four from a stockpile of the excavated sediments. No information is available regarding the exact location of these samples. The results of this testing are included as Appendix B and summarized in Table 2-1. Total cyanide (0.8 and 0.96 ppm), petroleum hydrocarbons (82 and 90 ppm) and various metals were detected. No VOCs, PAHs, PCBs or DDT were detected.

Based upon present activities performed at this site, there is no apparent source for the cyanide and PAH contamination detected in the drainage swale during the Phase I RI.

The Navy plans to build more magazines and bunkers in this area within ten years.

5.2.2.3 Description of the Thames River

The Thames River is a tidal estuary formed at the confluence of the Shetucket and Yantic Rivers in Norwich, Connecticut. It flows approximately 16 miles to Long Island Sound to the south. The Subase and the town of Groton are on the east bank of the river approximately 6 miles north of Long Island Sound. The City of New London is on the west bank of the river.

The Thames River is a salt wedge estuary. Depending on the time of year and climatological factors, the river can be highly stratified with freshwater on the surface and denser saline water on the bottom. Welsh (1984) estimated a freshwater flushing time of 0.5 to 2 days from Norwich to Long Island Sound. In comparison, he estimated a flushing time for bottom water of greater than 19 days.

Land development along the southern portion of the river is mostly industrial. Chemical companies, oil terminals, power plants, and waste water treatment plants occupy both banks of the river.

The CTDEP classifies the Thames River as SC/SB. This indicates that the river currently does not meet the goals for an SB water body (i.e., suitable for swimming and harvesting of shellfish and desirable to promote the restoration of an anadromous fishery). It is noted that CTDEP is currently considering changing the water classification to SC/SA.

A dredged channel runs north to south in the river. Depths in the dredged channel are approximately 40 feet below mean sea level. At the Subase, the width of the river ranges from 1500 to 3000 feet.

APPENDIX II

LYME DISEASE

APPENDIX II
LYME DISEASE

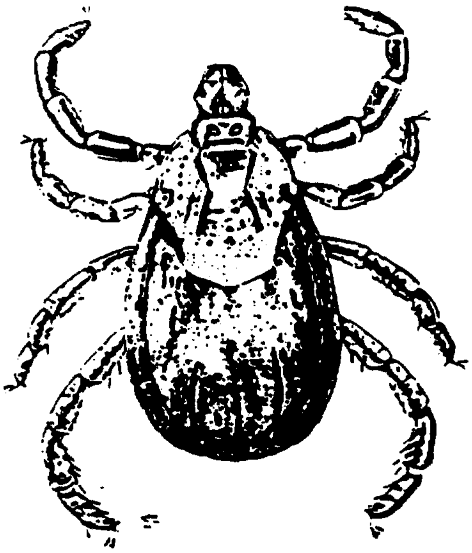
The occurrence of Lyme disease has become a worldwide problem since its identification in 1976. This disease is characteristically recognized as being transmitted by ticks, which may be encountered by field personnel while working at this site. As a result, this discussion has been included with this Health and Safety Plan to provide for adequate recognition, evaluation, and control efforts to minimize the occurrence and effects of this potential hazard.

The discovery of Lyme disease is credited to Dr. Allen Steere of Yale University Medical School, and is named after the community where it was (reportedly) first encountered, Lyme, Connecticut. This disease can be transmitted to man through the bite of ticks that are infected with a cork screw-shaped microbe (spirochete). The spread of this disease has been so rapid that in 1984 it surpassed Rocky Mountain Spotted fever as the most common tick-borne disease in the United States. In this country, most of the incidents of this disease have been recorded in the Northeast, and the tick species most commonly attributed with its spread is the deer tick.

Recognition

This hazard potential exists primarily in the spring and summer months, as these are the seasons that tick populations and activity flourish. In fact, 90 percent of the reported cases have occurred from early June through September. Also, this concern exists primarily in heavily vegetated areas. Therefore, recognition of these factors can aid in the awareness and control of this threat.

To aid in the recognition and identification of these insects, an example illustration of the tick species common to the region where this site is located has been included with this discussion. This species (the American Dog tick) is common in the eastern half of the United States, and typically exists in areas covered with grass or underbrush. These insects will attach themselves to animals (including man) that pass through the area and rub against them. After finding a host, the tick inserts its mouthparts and sucks blood until it is fully engorged. This requires a time period of three to twelve days, then the tick will drop off. In addition to Lyme disease concerns, this tick has also been identified as a transmitter of Rocky Mountain Spotted Fever, and the organisms of tularemia and possibly relapsing fever. The wounds left by tick bites can be painful, and can also have a paralyzing effect commonly referred to as tick paralysis.



An unengorged female American dog
tick, Dermacentor variabilis

The earliest symptom of the onset of this disease is the occurrence of an unusual red skin rash. This is commonly the first indication since it has been evidenced that many persons who have contracted this disease were, in fact, unaware that they had been bitten. This rash can appear at the site of the bite anywhere from several days to a few weeks after the bite. It typically starts as a small red spot, and then expands as the spirochetes expand from the bite location. Rash sizes can vary, but have been most commonly associated in a 2 to 3 inch diameter size range. This rash will fade (with or without treatment) after a few weeks. Close inspection is necessary to detect this symptom as the rashes are easy to miss because they're often very faint. Body sites where rashes frequently occur include the thigh areas, groin, and armpits. Also, it is not uncommon for a rash to develop in more than one place.

Other early symptoms include profound fatigue, a stiff neck, and flu-like symptoms such as headache, chills, fever, and muscle aches. Recognition of the onset of any of these symptoms is important since tick bites do not always produce a rash. If left untreated, the disease will progress to its second stage within weeks or months after the infection. This stage involves affects to the heart and nervous system. A common second stage symptom is a paralysis on one or both sides of the face. Others include severe headache, encephalitis, or meningitis. The third and final stage involves the development of chronic inflammatory arthritis, which can occur up to a year or more after the bite.

Evaluation

Evaluation of this hazard potential principally involves field personnel performing close self-inspections for the presence of ticks each time they leave the site. This should involve careful examination, especially of the individuals' heads. Personnel should be aware that when a tick attaches itself to its host, it inserts its entire head under the surface of the skin.

Control

Control of this threat involves several components. First, field personnel must be aware of the climate and area conditions which are commonly associated with being conducive to tick infestation. Second, when working in or walking through potential infested areas, personnel must ensure that they do not have exposed body parts (i.e. at least long sleeved shirts and long pants, particularly when protective coveralls are not worn). In heavily vegetated areas where infestation is likely, Tyvek coveralls will be required to minimize this hazard potential. Also, several commercial products have been demonstrated as being effective in repelling ticks. Examples include Permanone, Off!, and Cutter. These types of repellents will be used at the direction and discretion of the Brown & Root Environmental Health and Safety Officer, and only in accordance and observation of manufacturer's recommendations. In most instances, however, such repellents are typically applied to the outside surfaces of clothing (and not directly onto the skin), and should be applied also to shoe tops, socks, pants cuffs, and other areas most susceptible to ticks.

Tick Removal

In the event that a tick is discovered to be attached to a member of the field team, timely removal of the insect is critical to reducing the potential for contracting the disease. According to available information and research, there is apparently a grace period of at least a few hours from the time of the bite before the tick transmits the microbe (the spirochetes are not present in the mouth parts of the tick). However, the incident of a tick bite is frequently unnoticed, and the discovery of the tick may not occur until after this suspected grace period has already elapsed. Therefore, timely removal is very important. The preferred method of tick removal is to pull it out using tweezers or small forceps. In this method, the tick should be grasped as close to the mouth as possible, and then pulled steadily upward. Care must be exercised so as not to pull in a jerking motion as this can result in the head becoming detached. After the tick has been removed, disinfect the bite with rubbing alcohol or povidone iodine (Betadine). The tick must not be handled as the microbes can enter the body through any breaks in intact skin. The bite should be checked occasionally for at least a two-week period to see if a rash forms. If it does, medical attention must be promptly sought.

In order to provide for proper and timely response to the occurrence of a tick bite, the Health and Safety Officer will ensure that the site First Aid kit is properly equipped with medical forceps and rubbing alcohol, in addition to the standard kit contents. Also, an adequate supply of commercial insect (tick) repellents will be maintained onsite, and all personnel will be trained in its proper application and will be required to use it, at the direction of the Health and Safety Officer.

APPENDIX III

HEAT/COLD STRESS

APPENDIX III
HEAT/COLD STRESS

HEAT STRESS

The SSO shall visually monitor personnel to note for signs of heat stress. Field personnel will also be instructed to observe for symptoms of heat stress and methods on how to control it. One or more of the following control measures can be used to help control heat stress:

- Provide adequate liquids to replace lost body fluids. Personnel must replace water and salt lost from sweating. Personnel must be encouraged to drink more than the amount required to satisfy thirst. Thirst satisfaction is not an accurate indicator of adequate salt and fluid replacement.

- Replacement fluids can be commercial mixes such as Gatorade®.

- Establish a work regime that will provide adequate rest periods for cooling down. This may require additional shifts of workers.

- Cooling devices such as vortex tubes or cooling vests can be worn beneath protective garments.

- Breaks are to be taken in a cool rest area (77°F is best).

- Personnel shall remove impermeable protective garments during rest periods.

- Personnel shall not be assigned other tasks during rest periods.

- Personnel shall be informed of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress.

The heat stress of personnel on site may be monitored utilizing biological monitoring or the Wet Bulb Globe Temperature Index (WBGT) technique when workers are not wearing protective coveralls (i.e. Tyvek®). This method will require the use of a heat stress monitoring device.

One of the following biological monitoring procedures shall be followed when the workplace temperature is 70°F or above.

- Heart rate (HR) shall be measured by the pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/minute. If the HR is higher, the next work period should be shortened by 10 minutes (or 33 percent), while the length of rest period stays the same. If the pulse rate is 100 beats/minute at the beginning of the next rest period, the following work cycle should be shortened by 33 percent. The length of the initial work period will be determined by using the table below.

PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUES

Work-Rest Regimen	Work Load		
	Light	Moderate	Heavy
Continuous	80.0°F	80.0°F	77.0°F
75% Work-25% Rest, Each Hour	87.0°F	82.4°F	78.6°F
50% Work-50% Rest, Each Hour	88.5°F	85.0°F	82.2°F
25% Work-75% Rest, Each Hour	90.0°F	88.0°F	86.0°F

- Body temperature shall be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature at the beginning of the rest period should not exceed 99°F. If it does, the next work period should be shortened by 10 minutes (or 33 percent), while the length of the rest period stays the same. However, if the oral temperature exceeds 99.7°F at the beginning of the next rest period, the following work cycle shall be further shortened by 33 percent. OT should be measured at the end of the rest period to make sure that it has dropped below 99°F. At no time shall work begin with the oral temperature above 99°F.

NOTE: External temperatures in excess of those stated above shall be regarded as inclement weather. Work continuation, termination, or alteration of the work schedule will be at the discretion of the FTL and on site health and safety representative. The heat and cold stress related sections of this are applicable to the season when work will be completed.

COLD STRESS

The cold stress TLVs are intended to protect workers from the severest effects of cold stress (hypothermia) and cold injury and to describe exposures to cold working conditions under which it is believed that nearly all workers can be repeatedly exposed without adverse health effects. The TLV objective is to prevent the deep body temperature from falling below 36°C (96.8°F) and to prevent cold injury to body extremities (deep body temperature is the core temperature of the body determined by conventional methods for rectal temperature measurements). For a single, occasional exposure to a cold environment, a drop in core temperature to no lower that 35°C (95°F) should be permitted. In addition to provisions for total body protection, the TLV objective is to protect all parts of the body with emphasis on hands, feet, and head from cold injury.

Introduction

Fatal exposures to cold among workers have almost always resulted from accidental exposures involving failure to escape from low environmental air temperatures or from immersion in low temperature water. The single most important aspect of life-threatening hypothermia is the fall in the deep core temperature of the body. The clinical presentations of victims of hypothermia are shown in Table 1. Workers should be protected from exposure to cold so that the deep core temperature does not fall below 36°C (96.8°F); lower body temperatures will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences.

Pain in the extremities may be the first early warning of danger to cold stress. During exposure to cold, maximum severe shivering depends when the body temperature has fallen to 35°C (95°F). This must be taken as a sign of danger to the workers and exposure to cold should be immediately terminated for any workers when severe shivering becomes evident. Useful physical or mental work is limited when severe shivering occurs.

Since prolonged exposure to cold air, or to immersion in cold water, at temperatures well above freezing can lead to dangerous hypothermia, whole body protection must be provided.

1. Adequate insulating dry clothing to maintain core temperatures above 36°C (96.8°F) must be provided to workers if work is performed in air temperatures below 4°C (40°F). Wind chill cooling rate and the cooling power of air are critical factors. [Wind chill cooling rate

TABLE 1

PROGRESSIVE CLINICAL PRESENTATIONS OF HYPOTHERMIA*

Core Temperature		Clinical Signs
°C	°F	
37.6	99.6	"Normal" rectal temperature
37	98.6	"Normal" oral temperature
36	96.8	Metabolic rate increases in an attempt to compensate for heat loss
35	95.0	Maximum shivering
34	93.2	Victim conscious and responsive, with normal blood pressure
33	91.4	Severe hypothermia below this temperature
32	86.0	Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated but react to light; shivering ceases
31	87.8	
30	86.0	Progressive loss of consciousness; muscular rigidity increases; pulse and blood pressure difficult to obtain; respiratory rate decreases
29	84.2	
28	82.4	Ventricular fibrillation possible with myocardial irritability
27	80.6	Voluntary motion ceases; pupils nonreactive to light; deep tendon and superficial reflexes absent
26	78.8	Victim seldom conscious
25	77.0	Ventricular fibrillation may occur spontaneously
24	75.2	Pulmonary edema
22	71.6	Maximum risk of ventricular fibrillation
21	69.8	
20	68.0	Cardiac standstill
18	64.4	Lowest accidental hypothermia victim to recover
17	62.6	Isoelectric electroencephalogram
9	48.2	Lowest artificially cooled hypothermia patient to recover

* Presentations approximately related to core temperature. Reprinted from the January 1982 issue of American Family Physician, published by the American Academy of Family Physicians.

is defined as heat loss from a body expressed in watts per meter squared which is a function of the air temperature and wind velocity upon the exposed body.] The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required. An equivalent chill temperature chart relating the actual dry bulb air temperature and the wind velocity is presented in Table 2. The equivalent chill temperature should be used when estimating the combined cooling effect of wind and low air temperatures on exposed skin or when determining clothing insulation requirements to maintain the deep body core temperature.

2. Unless there are unusual or extenuating circumstances, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Older workers or workers with circulatory problems require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions which should be considered. The precautionary actions to be taken will depend upon the physical condition of the worker and should be determined with the advice of a physician with knowledge of the cold stress factors and the medical condition of the worker.

Evaluation and Control

For exposed skin, continuous exposure should not be permitted when the air speed and temperature results in an equivalent chill temperature of -32°C(-25.6°F). Superficial or deep local tissue freezing will occur only at temperatures below -1°C (30.2°F) regardless of wind speed.

At air temperatures of 2°C (35.6°F) or less, it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately provided a change of clothing and be treated for hypothermia.

TLVs recommended for properly clothed workers for periods of work at temperatures below freezing are shown in Table 3.

TABLE 2

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS EQUIVALENT TEMPERATURE (under calm conditions)*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Temperature (°F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148

(Wind speeds greater than 40 mph have little additional effect)	**LITTLE DANGER** In < hr with dry skin. Maximum danger of false sense of security	**INCREASING DANGER** Danger from freezing of exposed flesh within one minute.	**GREAT DANGER** Flesh may freeze within 30 seconds.
	Trenchfoot and immersion foot may occur at any point on this chart.		

* Developed by U.S. Army Research Institute of Environmental Medicine, Natick MA.

TABLE 3

THRESHOLD LIMIT VALUES WORK/WARM-UP SCHEDULE FOR FOUR-HOUR SHIFT*

Air Temperature - Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx)	°F (approx)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	(Norm Breaks)	1	(Norm Breaks)	1	75 min	2	55 min	3	40 min	4
-29° to -31°	-20° to -24°	(Norm Breaks	1	75 min	2	55 min	3	40 min	4	30 min	5
-32° to -34°	-25° to -29°	75 min	2	55 min	3	40 min	4	30 min	5	Non-emergency work should cease	
-35° to -37°	-30° to -34°	55 min	3	40 min	2	30 min	5	Non-emergency work should cease		Non-emergency work should cease	
-38° to -39°	-35° to -39°	40 min	4	30 min	1	Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease	
-40° to -42°	-40° to -44°	30 min	5	Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease	
-43° & below	-45° & below	Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease	

NOTES:

1. Schedule applies to moderate to heavy work activity with warm-up breaks of ten (10) minutes in a warm location. For Light-to-Moderate Work (limited physical movement): apply the schedule one step lower. For example, at -35°C (-30°F) with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period (Step 5).
2. The following is suggested as a guide for estimating wind velocity if accurate information is not available: 5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.
3. If only the wind chill cooling rate is available, a rough rule of thumb for applying it rather than the temperature and wind velocity factors given above would be: 1) special warm-up breaks should be initiated at a wind chill cooling rate of about 1750 W/M^2; 2) all non-emergency work should have ceased at or before a wind chill of 2,250 W/m^2. In general, the warm-up schedule provided above slightly under-compensates for the wind at the warmer temperatures, assuming acclimatization and clothing appropriate for winter work. On the other hand, the chart slightly over-compensates for the actual temperatures in the colder ranges, since windy conditions rarely prevail at extremely low temperatures.
4. TLVs apply only for workers in dry clothing.

* Adapted from Occupational Health & Safety Division, Saskatchewan Department of Labor.

Special protection of the hands is required to maintain manual dexterity for the prevention of accidents:

1. If fine work is to be performed with bare hands for more than 10-20 minutes in an environment below 16°C (60.8°F), special provisions should be established for keeping the workers' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars should be covered by thermal insulating material at temperatures below -1°C (30.2°F).

2. If the air temperature falls below 16°C (60.8°F) for sedentary, 4°C (39.2°F) for light, -7°C (19.4°F) for moderate work and fine manual dexterity is not required, then gloves should be used by the workers.

To prevent contact frostbite, the workers should wear anti-contact gloves.

1. When cold surfaces below -7°C (19.4°F) are within reach, a warning should be given to each worker by the supervisor to prevent inadvertent contact by bare skin.

2. If the air temperature is -17.5°C (0°F) or less, the hands should be protected by mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.

Provisions for additional total body protection are required if work is performed in an environment at or below 4°C (39.2°F). The workers should wear cold protective clothing appropriate for the level of cold and physical activity:

1. If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment.

2. If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of the clothing in use may be of a type impermeable to water. With more severe work under such conditions, the outer layer should be water repellent, and the outerwear should be changed as it becomes wetted. The outer garments should include provisions for easy ventilation in order to prevent wetting of inner layers of sweat. If work is done at normal temperatures or in a hot environment before entering the cold area, the

employee should make sure that clothing is not wet as a consequence of sweating. If clothing is wet, the employee should change into dry clothes before entering the cold area. The workers should change socks and any removable felt insoles at regular daily intervals or use vapor barrier boots. The optimal frequency of change should be determined empirically and will vary individually and according to the type of shoe worn and how much the individual's feet sweat.

3. If exposed areas of the body cannot be protected sufficiently to prevent sensation of excessive cold or frostbite, protective items should be supplied in auxiliary heated versions.

4. If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.

5. Workers handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperatures below 4°C (39.2°F) should take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of "cryogenic fluids" or those liquids with a boiling point that is just above ambient temperature.

Work - Warming Regimen

If work is performed continuously in the cold at an equivalent chill temperature (ECT) or below -7°C (19.4°F), heated warming shelters (tents, cabins, rest rooms, etc.) should be made available nearby. The workers should be encouraged to use these shelters at regular intervals, the frequency depending on the severity of the environmental exposure. The onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the shelter. When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing loosened to permit sweat evaporation or a change of dry work clothing provided. A change of dry work clothing should be provided as necessary to prevent workers from returning to work with wet clothing. Dehydration, or the loss of body fluids, occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee should be limited because of the diuretic and circulatory effects.

For work practices at or below -12°C (10.4°F) ECT, the following should apply:

1. The worker should be under constant protective observation (buddy system or supervision).

2. The work rate should not be so high as to cause heavy sweating that will result in wet clothing; if heavy work must be done, rest periods should be taken in heated shelters and opportunity for changing into dry clothing should be provided.

3. New employees should not be required to work full time in the cold during the first days of employment until they become accustomed to the working conditions and required protective clothing.

4. The weight and bulkiness of clothing should be included in estimating the required work performance and weights to be lifted by the worker.

5. The work should be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats should not be used. The worker should be protected from drafts to the greatest extent possible.

6. The workers should be instructed in safety and health procedures. The training program should include as a minimum instruction in:

    a. Proper rewarming procedures and appropriate first aid treatment.
    b. Proper clothing practices.
    c. Proper eating and drinking habits.
    d. Recognition of impending frostbite.
    e. Recognition of signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur.
    f. Safe work practices.

Special Workplace Recommendations

Special design requirements for refrigerator rooms include:

1. In refrigerator rooms, the air velocity should be minimized as much as possible and should not exceed 1 meter/sec (200 fpm) at the job site. This can be achieved by properly designed air distribution systems.

2. Special wind protective clothing should be provided based upon existing air velocities to which workers are exposed.

Special caution should be exercised when working with toxic substances and when workers are exposed to vibration. Cold exposure may require reduced exposure limits.

Eye protection for workers employed out-of-doors in a snow and/or ice-covered terrain should be supplied. Special safety goggles to protect against ultraviolet light and glare (which can produce temporary conjunctivitis and/or temperature loss of vision) and blowing ice crystals should be required when there is an expanse of snow coverage causing a potential eye exposure hazard.

Workplace monitoring is required as follows:

1. Suitable thermometry should be arranged at any workplace where the environmental temperature is below 16°C (60.8°F) so that overall compliance with the requirements of the TLV can be maintained.

2. Whenever the air temperature at a workplace falls below -1°C (30.2°F), the dry bulb temperature should be measured and recorded at least every 4 hours.

3. In indoor workplaces, the wind speed should also be recorded at least every 4 hours whenever the rate of air movement exceeds 2 meters per second (5 mph).

4. In outdoor work situations, the wind speed should be measured and recorded together with the air temperature whenever the air temperature is below -1°C (30.2°F)

5. The equivalent chill temperature should be obtained from Table 2 in all cases where air movement measurements are required; it should be recorded with the other data whenever the equivalent chill temperature is below -7°C (19.4°F).

Employees should be excluded from work in cold at -1°C (30.2°F) or below if they are suffering from diseases or taking medication which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to temperatures below -24°C (-11.2°F) with wind speeds less than five miles per hour, or air temperatures below -18°C (0°F) with wind speeds above five miles per hour, should be medically certified as suitable for such exposures.

Trauma sustained in freezing or subzero conditions requires special attention because an injured worker is predisposed to cold injury. Special provisions should be made to prevent hypothermia and freezing of damaged tissues in addition to providing for first aid treatment.

Note: This information has been adopted from the **1992-1993 "Threshold Limit Values** for Chemical Substances and Physical Agents and **Biological Indices**" by the American Conference of Governmental Industrial Hygienists (ACGIH).